

CLEAN WATER ACT
Section 404(c) Evaluation

BAYOU AUX CARPES
LOUISIANA



U.S. ENVIRONMENTAL PROTECTION AGENCY

Region 8
Dallas, Texas

JULY 1986

PART I.

RECOMMENDED DETERMINATION

and

TECHNICAL DOCUMENTATION

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A. RECOMMENDED DETERMINATION

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ENVIRONMENTAL PROTECTION AGENCY
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RECOMMENDED DETERMINATION TO PROHIBIT, DENY, OR RESTRICT
THE SPECIFICATION, OR THE USE FOR SPECIFICATION, OF AN AREA
AS A DISPOSAL SITE

INTRODUCTION:

The Regional Administrator of Region 6 of the Environmental Protection Agency (EPA) is recommending, by way of this notice, that the Administrator of EPA invoke the provisions of Section 404(c) of the Clean Water Act (33 U.S.C. 1251 et seq.). Section 404(c) provides that the EPA Administrator is authorized to prohibit the specification (including the withdrawal of specification) of any defined area as a disposal site, and he is authorized to deny or restrict the use of any defined area for specification (including the withdrawal of specification) as a disposal site, whenever he determines, after notice and opportunity for public hearing, that the discharge of dredged or fill materials into such area will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas), wildlife, or recreation areas. The procedures for implementation of 404(c) are set forth in 40 CFR 231.

Although one particular project (the Harvey Canal-Bayou Barataria Levee Project) is the focus of related court action (discussed below), there is no pending permit application currently being considered for the area in question by either the EPA or the U.S. Army Corps of Engineers (Corps). This action, therefore, is not an EPA "veto" of a Corps permit decision. Instead, the Regional Administrator is recommending a restriction on the use of the site described below. The restriction would be applicable to future permit applications* and to proposals for using the area as a Corps of Engineers dredged material disposal site.

* Substantial physical, biological, and other changes have occurred to warrant a new Section 404 application and/or review associated with any proposal to proceed with the original design, or another design, of the Harvey Canal-Bayou Barataria Levee Project.

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The Regional Administrator's decision to initiate the 404(c) process came about at this particular time partly as a result of recent judicial action. A suit was filed in 1977 by landowners who were interested in the completion of a project, which originated in the 1960's as a Corps flood control project (Harvey Canal-Bayou Barataria Levee Project). The landowners wanted the project completed according to the original design. This original design included levee-building, construction of a pumping station, and closure of some waterways. Land reclamation benefits would have been realized through the drainage of wetlands.

Over the years, EPA (and other agencies) continually objected to the original project design because of the potential significant adverse effects (primarily drainage of the wetlands) upon on this productive wetland ecosystem. In 1975, EPA recommended a modified design, which would replace the dams with flood gates and which would require that, if a pumping station was needed for flood control, it be operated so as to maintain the integrity of the wetlands. Although the Corps of Engineers actually accepted this recommendation at one point* (COE, Nov. 16, 1976) implementation of it was pre-empted by a law suit filed by landowners who would have benefited from the drainage project.

The latest step in the landowner's law suit occurred in the U.S. District Court for the Eastern District of Louisiana (on remand from the U.S. Court of Appeals for the 5th Circuit). Judge Lansing Mitchell issued an order which, in part, allowed EPA until December 18, 1984, to initiate a Section 404(c) proceeding on the project as originally designed. On December 18, 1984, EPA Region 6 initiated the 404(c) process with respect to that portion of the Bayou aux Carpes swamp owned by those landowners.

By the same action EPA initiated the 404(c) process for an additional area adjoining that property, but outside of the realm of the area being considered in the specific case before the District Court. Together, both of these tracts comprise the approximately 3,000 acre Bayou aux Carpes study area, which is the subject of this recommendation. The impacts from both the originally designed Harvey Canal-Bayou Barataria Levee Project and other activities which would require a Section 404 permit have been evaluated.

*The Corps of Engineers subsequently denied a permit application from Jefferson Parish for constructing a pumping station at Bayou aux Carpes. The application was submitted in response to an order from the 24th Judicial District Court, State of Louisiana.

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On May 10, 1985, EPA Region 6 issued a proposed determination* to prohibit the specification of the Bayou aux Carpes study area for the discharge of dredged or fill material. This proposal was made based on the likelihood of unacceptable adverse impacts to shellfish beds or fishery areas (including spawning and breeding areas), wildlife, and recreation resources.

A public hearing was conducted in Gretna, Louisiana on June 18, 1985 in order to accept comments on the proposed determination. Public participation at the hearing and during the comment period (ending August 19, 1985) was substantial. Support was expressed both for and against the proposal. The EPA proposal was supported by the National Park Service, the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, the Louisiana Department of Wildlife and Fisheries, the Louisiana Department of Natural Resources, numerous environmental and civic groups, and many citizens with an interest in the area. Those opposing the proposal included some owners of land within the study area and several business organizations promoting the industrial development of the Gulf Intracoastal Waterway (Bayou Barataria) frontage.

The U.S. Army Corps of Engineers has also requested that EPA exclude from the proposed restriction an area for the disposal of dredged material from the Gulf Intracoastal Waterway (Bayou Barataria). That segment of the waterway has never been dredged since the initial construction. According to the Corps (COE, Aug. 15, 1985), the segment is not expected to require maintenance in the near future. The adverse impacts to fish and wildlife resources as a result of such disposal are projected to be significant and unacceptable, as discussed below. For that reason, alternative disposal sites should be utilized if and when maintenance dredging is required along this approximately 3.7 mile segment of the 95 mile project between the Mississippi River and the Atchafalaya River.

DESCRIPTION OF THE SITE:

The Bayou aux Carpes study area is located approximately 10 miles south of New Orleans, Louisiana, on the "West Bank" of Jefferson Parish. The area is bounded on the north by the east-west Estelle Pumping Station Outfall Canal, on the east by the Plaquemines-Jefferson Parish line, on the south by Bayou Barataria and Bayou des Familles, and on the west by State Highway 3134 and the "Vee-Levee" pipeline canal. The geographic coordinates are:

* Published in the Federal Register on May 17, 1985.

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Range 23 East, Township 15 South, Portions of Sections 13, 14, 55, 57, 59;
Range 24 East, Township 14 South, Portions of Sections 55, 81, 82; and
Range 24 East, Township 15 South, Portions of Sections 48, 49, 50, 52, 57.

Maps of the study area are attached.

The southwest border of the study area is adjacent to the Barataria Unit of the Jean Lafitte National Historical Park. About 600 acres of the Barataria Unit lies within the Bayou aux Carpes drainage area. The Park lands are hydrologically connected to the Bayou aux Carpes study area via four sets of culverts under Louisiana Highway 3134.

The Bayou aux Carpes study area is a part of the Barataria Basin hydrologic unit. The area is subject to slight tidal effects and appears primarily as a freshwater to weakly brackish aquatic system. Wind appears to be the primary force affecting water levels in the study area. Water transport from Bayou aux Carpes to Bayou Barataria is generally rapid and directed towards Barataria Bay. The potential for flooding over the majority of the study area due to rising water in Bayou Barataria exceeds 50 percent of the time (EPA, Jan. 1985).

Levees span virtually the entire perimeter of the Bayou aux Carpes study area. The two mile long Southern Natural Gas Pipeline canal provides the primary hydrological connection between the study area and Bayou Barataria (Gulf Intracoastal Waterway) and, ultimately, Barataria Bay. During the construction of the Southern Natural Gas Pipeline Canal and several shorter unmaintained drill hole canals (no producing wells exist in the study area) dredged materials were deposited along the canal banks. The levees generally rise no more than a few feet. Aside from the relatively flat topography, numerous breaks in the levees and the unfilled area at the head of the Southern Natural Gas Pipeline Canal provide a pathway for surface water to exchange between the canals and surrounding swamps and marshes. Remnants of the original Bayou aux Carpes waterway are unleveed, thus allowing surface water to sheet flow across to the adjoining wetlands.

The study area is a diverse estuarine ecosystem covering approximately 3,000 acres in the upper reaches of the Barataria Bay Basin. Approximately 71 percent of the study area is comprised of forested wetlands, shrub wetlands, and cypress swamps while approximately 21 percent is represented by marshlands, ponds, and open waterways. The remainder of the study area consists of land classified as old orchard, residential, agricultural, industrial, wooded upland, and grassland associated with levees and roads (EPA, June 19, 1985).

Bald cypress (Taxodium distichum), tupelo-gum (Nyssa aquatica), green ash (Fraxinus pennsylvanica), and red maple (Acer rubrum), are common overstory vegetation in the forested wetland areas while softstem bullrush (Scirpus validus), bulltongue (Sagittaria falcata), pennywort (Hydrocotyle bonariensis),

iris (Iris giganticaerulea), smartweed (Polygonum spp.), spikerush (Eleocharis spp.) and alligator weed (Alternanthera philoxeroides), are typical of the marsh regions of the study area. Water-hyacinth (Eichhornia crassipes), and duckweed (Lemna spp.) characterize the floating vegetation of the bayou and canals in the study area (EPA, June 19, 1985 and USFWS, 1985).

ECOLOGICAL VALUES ASSOCIATED WITH THE SITE:

As it currently exists, the Bayou aux Carpes study area is a viable and valuable wetland area*, which is a functioning component of the Barataria Bay and estuarine system. Seasonally flooded forested wetland areas, such as are found here, are considered among the most biologically productive of all wetland ecosystems. Despite the existing alterations, mainly levees and canals, the Bayou aux Carpes study area provides local and regional benefits in terms of water storage and release, habitat for the production and growth of freshwater and estuarine fish and shellfish, nutrient processing, and a source of organic matter for export to Barataria Bay. These values are elaborated upon below.

A. Local Values

The assemblage of finfish species is diverse and is indicative of a stable fisheries community in a relatively unstressed environment. Water quality is good and there is adequate interchange between the waterways and adjacent wetlands to allow for their use as spawning and nursery areas (EPA, Jan. 1985; LDNR, July 1985; USFWS, 1985). The interchange of water also promotes significant nutrient and detrital transport (EPA, Jan. 1985).

At least twenty-three species of freshwater fishes are reported to be associated with the Bayou aux Carpes drainage area. The area provides sport fishing opportunities for channel and blue catfish, sunfish, bluegill, and largemouth bass (EPA, Jan. 1985; Day, 1984; USFWS, 1985).

The local fishery resource value assumes an even broader geographical significance since adult and juvenile forms of some freshwater species move from the traditional freshwater regions of the Barataria Basin towards the Gulf in the fall and early winter. There they replace marine species immigrating from the estuary to the Gulf. As summer approaches, salinity and temperature increase and the freshwater forms retreat back to the upper freshwater zones of the basin (Day, 1984).

* Within the study site, several areas of non-wetlands occur (approximately 150 acres in total), primarily along the natural levee ridge of Bayou des Familles.

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In addition to finfish, field sampling (EPA, Jan. 1985) yielded 14 taxa of macroinvertebrates from stations in the canals and bayou and 27 taxa of macroinvertebrates from the marsh and swamp areas. Many of these macroinvertebrates (juvenile crawfish, grass shrimp, and amphipods) are important as fish food items. Others, including blue crab and adult red swamp crawfish, are of direct commercial value.

The study area also provides valuable habitat for a diversity of wildlife species. The marshlands and forested wetlands provide feeding, resting, nesting, and escape habitat to numerous species of game and nongame mammals and commercially important furbearers, songbirds, raptors, migratory and resident waterfowl, wading birds, woodpeckers, other birds, and many species of amphibians and reptiles (USFWS, 1985).

During the field studies (EPA, Jan. 1985 and USFWS, 1985), at least 70 species were observed, including nine species of amphibians, 10 species of reptiles, 45 species of birds, and six species of mammals (EPA, Jan. 1985 and USFWS, 1985). Of those species observed, the wood duck, bald eagle, and American alligator are considered by the Fish and Wildlife Service to be National Species of Special Emphasis. In addition, the pileated woodpecker has been highlighted by the Fish and Wildlife Service Regional Resource Plan for the Southeast Region. The endangered bald eagle is known to nest in the general vicinity of the Bayou aux Carpes study area. At least three bald eagle nests have been documented within a 10 mile radius of this area (USFWS, Nov. 13, 1984).

B. Regional Values

1. Hydrology

The relatively flat topography of the study area, in combination with the low and/or broken levees, enhances the capacity of the study area to detain surface waters and affect a slow release to downstream systems. The water storage capacity of the study area was confirmed by measuring the cyclic chloride concentrations of swamp water discharged to Bayou Barataria and by monitoring a dye tracer. The storage capacity is significant in that water which is frequently introduced into the study area from Bayou Barataria contains urban runoff from the surrounding area. While the water is temporarily detained in the Bayou aux Carpes area, heavy metals are deposited in the sediments. Also, inorganic nitrogen is biologically processed into other compounds, including plant and animal matter, which are then subject to export to downstream areas (EPA, Jan. 1985 and Day, 1985).

2. Contribution to the Barataria Bay Estuary

Barataria Bay is one of the most productive estuarine areas along the Louisiana coast. Louisiana estuaries owe their high level of productivity to the extensive systems of marshes and swamps in the upper basins. These

upper basin regions, such as the Bayou aux Carpes study area, provide the drainage necessary to maintain the broad, stable brackish zones in the estuary (Day, 1984).

EPA field studies (EPA, Jan. 1985) demonstrated a hydrological connection between the study area and the Barataria Bay estuary. This pathway appears to have been operational each month of the year in 1984, thus providing a route for the exchange of both nutrients and aquatic life.

Field data indicate that the Bayou aux Carpes study area is seasonally brackish and several of the species collected in the area can tolerate both fresh and saline environments. Observations of bay anchovy, striped mullet, threadfin shad, tidewater silverside, and blue crab provided recent evidence of ingress and egress by estuarine organisms (EPA, Jan. 1985 and USFWS, 1985). The Louisiana Department of Natural Resources has stated that "these wetlands provide not only important wildlife habitat, but act as nursery grounds for many estuarine dependent species of recreational and commercial value to the State of Louisiana" (LDNR, July 10, 1985).

EPA has found that habitats further downstream rely on the freshwater wetlands in the study area for their sources of important nutrients. The forested wetlands of the upper Barataria Basin export large amounts of nitrogen, phosphorus, and carbon to the estuaries of the lower basin. This is a major source of the energy which fuels the high productivity of the Louisiana coastal ecosystems (Day, 1984).

The amount of plant biomass produced in the study area, although not directly measured, appears to be comparable to that measured in nearby sites (Conner and Day, 1976; EPA, Oct. 1980; USFWS, March 1982; USFWS, March 1984) exhibiting similar species composition. This plant biomass is significant because it serves both as an important direct food source for numerous species of fish and wildlife that live on or visit the project site, and as a source of detritus (i.e., plant and animal material undergoing various stages of decay by the action of bacteria and fungi). Detrital material constitutes a large fraction of the diet of fishes and invertebrates and thereby contributes to the downstream estuarine food webs. By this mechanism, recreational and commercial fish and shellfish resources are supported.

EPA field and laboratory studies confirmed that the Bayou aux Carpes study area is a source of organic carbon and nitrogen to Bayou Barataria, leading to Barataria Bay. Nutrient exchange measurements and dye tracer studies verified the export mechanism. During the study period, water transport from Bayou aux Carpes to Bayou Barataria was rapid and directed towards Barataria Bay. Traced waters leaving the Bayou aux Carpes study area via the Southern Natural Gas Pipeline canal traveled downstream in Bayou Barataria a distance of six miles in less than 24 hours (EPA, Jan. 1985).

The denitrification process is an efficient and important function of forested swamps, as well as tidal marshes. The biological cycling of inorganic nitrogen was evident in the Bayou aux Carpes study area. Bayou

Barataria was found to be the primary source of inorganic nitrogen and the study area was found to be a principal site for its assimilation into other nitrogen forms, such as animal and plant protein. Concentration gradient studies revealed that the study area is a significant source of organic matter exported to the lower Barataria estuarine system (EPA, Jan. 1985).

In summary, EPA studies confirm the determination of the Louisiana Department of Natural Resources that the Bayou aux Carpes study area "plays a vital role in the functioning of the estuarine system by contributing organic matter and acting as a buffer between adjacent developed areas and the lower estuary." Further, the state agency advised EPA that the study area is "an important element in the upper Barataria estuary and will be considered a key component of the system when the Louisiana Department of Natural Resources initiates a future study for special area management of the upper Barataria basin" (LDNR, July 10, 1985).

3. Recreation

The Barataria Unit of the Jean Lafitte National Historical Park lies within the same drainage basin as the Bayou aux Carpes study area and is ecologically similar to the study area. Since there is a direct hydrological connection, ecological conditions in the study area have a strong influence on the 600 acre Park segment. The vegetation within the Park contains significant undisturbed areas of three major forest types: ridge, bottomland hardwood, and cypress-tupelo. Most natural levee areas in south Louisiana have been extensively developed and the study area is one of the very few, and perhaps the only protected area, where all three communities remain in the natural state (Day, 1984). Park management plans call for the unit to be maintained as a "protected representative natural community subzone" (NPS, Oct. 12, 1984).

The Park Service has also placed an emphasis on this area as an educational resource. An interpretative walkway traverses typical bottomland forested wetlands, then enters a cypress-tupelo swamp. The trail receives high visitor use and is a major tool in the Park's education program. In addition, an "environmental education group use site" that is planned would rely heavily on the swamp area adjacent to the Bayou aux Carpes study area (NPS, Oct. 12, 1984 and NPS, Aug. 7, 1985).

Recreational opportunities such as boating, fishing, trapping, and some hunting are also available within the bounds of the study area. The public currently has access to portions of the tract by way of the major watercourses.

C. Summary of Values Assessment

The recent EPA Section 404(c) evaluation has confirmed the conclusions regarding the ecological values of the study area which were described

in the March 31, 1976, EPA Region 6 review of the Harvey Canal-Bayou Barataria Levee Project (Appended to EPA, Jan. 1985). The site is a productive and functioning component of the Barataria Bay system. The ecological and recreational values are numerous and are evident at both the local, on-site level as well as the broader regional level.

POTENTIAL ADVERSE IMPACTS OF SECTION 404 PERMIT ACTIVITIES:

A. Cumulative and Regional Impacts

As reported by the Department of Commerce (USDC, 1980), Louisiana is the third ranking state in fisheries employment and the state's estuarine system produces 28 percent of the nation's fishery harvest. The Corps of Engineers recently estimated that 40 percent of the nation's fur catch came from coastal Louisiana marshlands. They also report that "[s]portsmen spend 25 million user-days each year hunting and fishing in this incredibly productive area. In 1983, the value of the fish and wildlife resources was \$450 million" (COE, 1984).

The national and statewide significance of these resources was summarized by the Department of Commerce thusly: "The coastal and marine resources of the Louisiana coastal zone, including living and non-living resources, recreation, fish, wildlife, estuarine, and water and land resources, are values of prime importance to the people and economy of the State and the nation." And yet, it is an area experiencing increasing pressures for wetland conversion and economic development (LDTD, 1978 and USDC, 1980).

In a report to the Joint Legislative Committee on Natural Resources, Dr. Sherwood Gagliano stated that over the last 80 years, over 800,000 acres of land in coastal Louisiana have been lost. Approximately 58 percent of this has occurred over the past 25 years. In other words, his findings clearly indicate a geometric, rather than arithmetic, rate of coastal land loss in Louisiana (Gagliano, 1981).

Recent losses of forested wetlands in the state are on the order of 87,200 acres annually (USFWS, March 1984) and the losses of estuarine wetlands in Louisiana have been reported at a rate of 25,000 acres, or 40 square miles, per year (USFWS, March 1984; COE, 1984; Dozier et al.; and Gagliano, 1981). This is extremely significant in light of the fact that Louisiana possesses approximately 41 percent of the coastal marshes in the coterminous U.S. (COE, 1984). Aside from the biological, water quality, recreational, and flood protection benefits which are being affected, economic impacts are also being realized. The U.S. Fish and Wildlife Service has found that Louisiana's "multi-million dollar commercial inshore shrimp fishery is directly proportional to the area of intertidal emergent wetland" (USFWS, March 1984).

The causes cited for these wetland losses include such natural phenomena as coastal subsidence and compaction, erosion, and sea level rise, and

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such anthropogenic causes as channelization, levee construction, canal dredging, subsidence due to mineral extraction, agricultural expansion, and urban expansion. Many of the second group of activities fall under the jurisdiction of Section 404 of the Clean Water Act. In fact, it has been predicted in a report by the Department of Commerce that "if the present draining and filling operations for urban and commercial development in the coastal area continue at the current rate, an additional 186,000 acres of the state's wetlands will be lost by the year 2000" (USDC, 1980).

The same types of activities causing significant statewide coastal wetland losses are also reported by the Department of Interior as major influences in the Barataria Basin, within which the study area lies (USFWS, 1983). The Louisiana Department of Transportation and Development (LDTD, 1976) has calculated the total land loss of Barataria Basin wetlands as being 44,800 acres by 1970.

A significant and adverse cumulative effect would result if the study area wetlands were to be drained or converted to urban or agricultural uses. The upper Barataria Basin wetlands are increasingly being ringed by urban development. This can be seen along the Bayou des Familles ridge to the northwest of the Estelle Pumping Station Outfall Canal. Also, the effects of pumping upon habitat similar to that of the study area may be seen immediately west of that canal.

In order to evaluate the potential cumulative effects of the loss or degradation of the 3,000 acre study area wetland tract within the context of the Barataria Basin, a general idea of the scale of the economic value of the tract was found useful. The value of an acre of wetland in the Barataria Basin has been estimated to be \$9,058.93 annually (USDC, 1980 and USFWS, May 1984). This value was computed in 1978 and accounts for only commercial and recreational fishing, commercial trapping, and recreation. The figure does not account for all benefits provided by the wetlands, omitting such factors as flood control and waste treatment. Using this estimate, a predictably conservative value of the study area wetlands in terms of fish, wildlife, and recreation benefits alone would amount to approximately \$27 million annually. This estimate would not account for the additional positive influences from the hydrologically connected Jean Lafitte National Historical Park. The value might also be considered understated because the study area represents a notable portion, roughly four percent of the periodically flooded marsh and swamp area in the expansive Barataria Basin (derived from USFWS, 1983). The Barataria Basin is responsible for a large, if not the largest, share of Louisiana's total commercial fishery harvest (Craig and Day, 1977 and EPA, Jan. 1985).

Therefore, based on EPA's findings of the wetland values and functions of the Bayou aux Carpes study area, it can be seen that unacceptable adverse cumulative and regional impacts would be likely to result from the loss or degradation of these wetlands.

B. Jean Lafitte National Historical Park

Adverse effects upon recreation (primarily from the potential loss of sport fishing and hunting opportunities) associated with the deposition of dredged or fill material within the study area is predictable and has been substantiated by a high level of public concern throughout the public hearing comment period. Also of great concern with regard to recreational opportunities are the potential effects which some disposal activities might have on the Jean Lafitte National Historical Park. The core area of the Barataria Marsh Unit of the Park, administered by the National Park Service, adjoins the Bayou aux Carpes study area on its western border and has a direct hydrological and ecological connection to the study area.

Completion of the Harvey Canal-Bayou Barataria Levee Project as originally proposed, or any other project which would have the effect of draining, drying, or hydrologically isolating the Bayou aux Carpes study area, would adversely affect the Jean Lafitte National Historical Park.

The hydrological relationship is such that attempts to drain or significantly alter the hydrology of the study area would result in adverse hydrological alterations within the Barataria Unit of the Park. These changes would have a significant and undesirable effect on recreational use of the Park and would seriously diminish the capacity of the Park to meet its legislative directive to "preserve for the education, inspiration, and benefit of present and future generations significant examples of natural and historical resources of the Mississippi Delta region..." (Public Law 95-625, November 10, 1978).

Park Superintendent James L. Isenogle stated at the public hearing that completion of the Harvey Canal-Bayou Barataria Levee Project,

"would so profoundly impact the aquatic system of the Barataria Unit of the Park as to invite serious questions as to the area's viability as a part of the National Park system. It should be noted that Public Law 95-625, the law that authorized the park, also established a park protection zone contiguous to the core of the Barataria Unit. The purposes of this zone are to '...protect the following values in the core area: 1) fresh water drainage patterns from the park protection zone into the core area; 2) vegetative cover; 3) integrity of ecological and biological systems; and 4) water and air quality.' Certainly if the Bayou aux Carpes Project were to proceed, those values in much of the core area would be quite literally, destroyed" (EPA, June 1985).

A study of the effects that leveeing and draining the study area would have on the Park was conducted by John W. Day, Jr., of the Louisiana State University Center for Wetland Resources (Day, 1984). Dr. Day concluded that as long as the surface water connection remains functional, the "forced drainage of the Bayou aux Carpes swamp would also result in drainage of much of the area within the park. This would lead to an increase in the number of upland species, and most of the wetland area would be lost."

Specifically, Dr. Day projected that the predominant transition to upland species following drainage would be punctuated by some shallow ponding, resulting from subsidence. Flood-tolerant shrub species would be found in these areas, which would be expected to exhibit about half the level of productivity of the former swamp and bottomland hardwood forests. The larger area of upland habitat would also be expected to exhibit lower productivity than the existing wetland habitat. In addition, organic matter export would be substantially lower and the ability of the Barataria Unit to absorb excess flood waters would be essentially lost. Due to the dramatic changes in plant community structure and trophic dynamics, the wildlife habitat values of the existing Park wetlands would be lost. Similarly, the habitat for resident finfish and crustaceans, as well as for both marine and fresh water migratory species, would be lost along with the attendant recreational opportunities.

Alternative means of preserving the wetland values of the Park if the study area was placed under pump would include placing control structures at the highway culverts and implementing an intensive water management plan. Although the control structures might initially slow the rate of ecological transformation due to draining, EPA has found that the option of constantly maintaining flooded conditions would eventually lead to the deterioration of the cypress-tupelo and bottomland hardwood communities. Shallow open water would become the predominant habitat type. Attempts to reproduce natural hydrological cycles through extensive water management would be expensive, involving major alterations in order to variously pump water into the area and then drain it out again. Such a system would be incompatible with the goals of the National Park Service and result in the loss of many of the existing wetland values such as nursery habitat and materials export (Day, 1984 and NPS, Aug. 7, 1985).

In addition to the Harvey Canal-Bayou Barataria Levee Project, other types of activities conducted in the study area which would require a Section 404 permit would potentially affect the ecological and/or recreational values of the Barataria Unit. This portion of the National Park and the Bayou aux Carpes study area represent, in form and in function, two ecologically interconnected segments of one wetland system.

C. Fish, Shellfish and Wildlife Resources

The loss or degradation of fish and wildlife resources resulting from the proposed Harvey Canal-Bayou Barataria Levee Project has been a point of concern to the U.S. Fish and Wildlife Service since the early 1960's. Several reviews of project alternatives conducted in 1962 concluded that levee construction and land conversion would result in an irreversible and significant loss of wooded swamp and marsh habitat, along with the associated fish and wildlife values. In 1975, the U.S. Fish and Wildlife Service Regional Director recommended that the application for a permit to install a pumping station at Bayou aux Carpes be denied, that the existing dam across Bayou aux Carpes be removed, and that no further construction of

the levee system be permitted. These recommendations were based on the same concerns expressed a decade earlier. Again, in 1984, the Fish and Wildlife Service concluded that the originally proposed project would bring about the destruction of valuable wetlands which provide habitat for numerous species of resident and migratory wildlife (USFWS, Nov. 14, 1984). Additionally, the Fish and Wildlife Service has found that the fish and wildlife resources of the Barataria Unit of the Jean Lafitte National Historical Park would be adversely affected by drainage of the study area (EPA, June 18, 1985).

The wildlife species which would be adversely affected would include an endangered species, several National Species of Special Emphasis, commercially important furbearers, and game animals. The project would also induce adverse impacts on fishery resources by eliminating habitat, reducing materials export to lower estuarine areas, and affecting water quality by compounding the eutrophication problems in the upper Barataria Basin (Craig and Day, 1977).

The deposition of dredged or fill material specifically associated with the completion of the Harvey Canal-Bayou Barataria Levee Project has been the focus of the Fish and Wildlife Service reviews. Their review of each aspect of the project, however, demonstrates that other potential projects involving Section 404 activities would also adversely impact fish, shellfish, and wildlife resources. Those separate activities evaluated include deposition associated with: levee construction and repair; the completion of closure dams across Bayou des Familles, the Southern Natural Gas Pipeline Canal, and Bayou aux Carpes; the construction of ancillary drainage canals; the conversion of the wetlands to residential and commercial land uses; and urban expansion surrounding the study area which would have offsite impacts (EPA, June 18, 1985).

Most recently, the Fish and Wildlife Service* conducted a population survey and prepared a Habitat Evaluation procedure (HEP) report (USFWS, 1985) for the study area and the Barataria Unit of the Jean Lafitte National Historical Park. The wildlife species selected for evaluation were representative of a broad array of community positions (e.g., trophic levels, habitat requirements, taxonomic groupings), as well as recreational, commercial, and aesthetic values. The results indicated that the bottomland hardwood wetlands and swamp and marsh habitats were generally of moderate to high value for the species evaluated.

* Other agencies represented by biologists on the team included the National Park Service, U.S. Army Corps of Engineers, and Louisiana Department of Wildlife and Fisheries. A representative from EPA also served as an ex-officio member of the evaluation team.

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The projections of future conditions, prepared as a part of the HEP analysis, indicated that with the implementation of Section 404(c), only slight changes in habitat value, due to the effects of natural ecological succession, would occur. If, however, the study area were to be enclosed by levees and drained, all evaluation species would be expected to show habitat value losses. Development of the converted lands would cause virtually all of the habitat value to be lost.

The HEP analysis also included a projection of the impacts from the deposition of fill material in the absence of drainage. The results showed that the filled areas would become vegetated with upland species, presenting correspondingly lowered habitat values for wetland-associated fish and wildlife populations. An additional activity examined was that of increased canalization, such as that associated with mineral development. This type of activity was projected to reduce fish and wildlife productivity by disrupting sheet flow and nutrient recharge of the wetlands.

Another federal agency with expertise regarding finfish and shellfish is the National Marine Fisheries Service. They also recognize that the study area is utilized by estuarine organisms and that the area provides many benefits which contribute to downstream, estuarine productivity. They concurred with EPA's May 10, 1985, preliminary findings that the deposition of dredged or fill material within the study area would have significant and adverse impacts within the study area, downstream towards Barataria Bay, and within the Barataria Unit of the Jean Lafitte National Historical Park (NMFS, June 17, 1985).

Similar findings resulted when the U.S. Army Corps of Engineers evaluated the Section 404 permit application associated with the Harvey Canal-Bayou Barataria Levee Project in 1979 by way of an Environmental Assessment and Findings of Fact. As a result of that review, the Section 404 permit was denied in 1980 based on, among other factors, the availability of alternative non-wetland sites, and the potential adverse impacts to the Jean Lafitte National Historical Park and to fish and wildlife resources (COE, Aug. 28, 1980).

By letter dated July 10, 1985, the Louisiana Department of Natural Resources also concluded that the study area wetlands "provide not only important wildlife habitat, but act as nursery grounds for many estuarine dependent species of recreational and commercial value to the State of Louisiana." Their historical analysis revealed that between the years 1956 and 1983 no major changes in wetland types occurred. However, an increase in open water areas was evident, as well as in increase in uplands, primarily levees or spoil banks. Aside from the direct loss of fish and wildlife resources, a major concern of the State appears to be the potential loss of the study area as an ecological "buffer between adjacent developed areas and the lower estuary" (LDNR, July 10, 1985).

This buffer could be compromised by projects which entail the drainage and conversion of these wetlands to agricultural, residential, or commercial uses. The dredging of canals and pipelines could also affect the study area wetlands by causing a reduction in sheet flow, which transports nutrients and organic matter into and out of the wetlands. If the placement of canals and associated spoil banks result in impounding the wetland, productivity of the site would decline due to impeded germination of trees and the succession to aquatic herbaceous growth and small water-tolerant shrubs (COE, 1981; Day, 1984; NPS, Aug. 7, 1985).

The adverse impacts of canalization and the implications for Barataria Bay fisheries were evaluated by John Day in a report for the National Park Service (Day, 1984) as follows:

"Canals are another way in which urban and agricultural runoff can by-pass the swamps and marshes and proceed directly into the wetland areas in the lower basin. Because wetlands act as a way to upgrade water quality, this skirting of wetland areas may increase the chance of eutrophication of the lower basin waterbodies due to the high nutrient-load of the runoff water (Kemp 1978)*.

Hopkins and Day (1979)* found that Lake Cataouatche and, to a lesser extent, Lake Salvador have already begun to experience the effect of an altered hydrological regime. These lakes in the Barataria Basin used to be a prime nursery ground for Louisiana commercial fisheries, but now drainage canals from the West Bank of New Orleans bypass the swamps and enter directly into the lakes. High nutrient loads from the West Bank have caused Lake Cataouatche to become eutrophic and fish kills after large rainstorms are indicative of the impact of the changes in the natural hydrology of this once productive area. The Barataria Waterway also allows urban runoff to flow unhindered to the upper part of Barataria Bay. Harmful substances can no longer be trapped by wetlands, and therefore flow straight into water bodies. There have also been reports of increased occurrences of salt water intrusion into the freshwater areas of the Barataria Basin because of these dredged canals (Conner and Day, 1980)*."

Finally, the findings from these federal and state agencies with various responsibilities for protecting fish and wildlife resources added much

* Citations available in Day, 1984.

to the current EPA review under Section 404(c) of the Clean Water Act. However, EPA concern regarding the effects from projects involving the discharge of dredged or fill material in this area is not new. EPA has conducted reviews of the Environmental Impact Statements and Section 404 permit applications for two other large-scale projects (the Marrero-Lafitte Waterline Project and the West Bank Hurricane Protection Levee Project) which would affect this same area. As a part of these reviews, EPA became involved in extensive negotiations regarding the protection of these wetland resources. EPA has thereby historically recognized this area as a sensitive, valuable wetland worthy of special protective measures, and yet continually subject to project proposals which would adversely affect its wetland characteristics, including the associated fish and wildlife resources.

In order to verify, update, and expand previous evaluations, EPA conducted field studies in January 1985 and documented them in a report entitled, "A Hydrological, Chemical, and Biological Assessment of Bayou aux Carpes, New Orleans, Louisiana" (EPA, Jan. 1985). Additional field surveys and a photointerpretive study based on recent infrared photography (EPA, June 19, 1985) added further support to the concerns for fish and wildlife resources highlighted in the Region 6 "Proposed Determination to Prohibit, Deny, or Restrict the Specification or the use for Specification, of an Area as a Disposal Site; Notice and Public Hearing," published in the Federal Register on May 17, 1985. EPA also examined the review of these and other studies prepared by Steimle and Associates, consultant to some of the landowners.

This review confirmed previous EPA evaluations and the findings of other agencies, as reported above, with regard to the existing value and the potential for unacceptable adverse impacts upon fish and wildlife resources. The bottomland hardwood wetlands and the wooded swamp and marsh habitat, in conjunction with the waterways, provide valuable feeding, breeding, and nursery habitat for numerous species of finfish, shellfish, and wildlife. Furthermore, the tidal exchange, which provides the mechanism for detrital export and the ingress and egress of estuarine fauna, indicates the scope of the potential impacts.

D. Section 404(c) Criteria

Unacceptable adverse effects on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas), wildlife, and recreation areas are the four criteria which may individually or jointly be used as the basis for an EPA decision to invoke the provisions of Section 404(c) of the Clean Water Act. In making this determination, any written findings of compliance with the EPA "Guidelines for Specification of Disposal Sites for Dredged or Fill Material" (40 CFR Part 230) shall also be considered.

An "unacceptable adverse effect" is defined as an impact which would be likely to result in a significant degradation in any of the criteria areas (40 CFR 231.2(e)). In the determinations made under Section 404(c) of the

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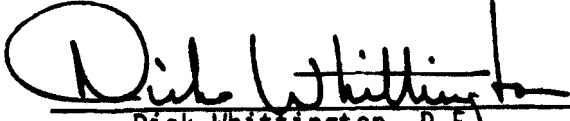
of permits for Clean Water Act Section 404 activities to be conducted in the Bayou aux Carpes study area wetlands. For that reason, it is recommended that the use of the Bayou aux Carpes study area as a disposal area for dredged or fill material be restricted. This recommendation applies to the Harvey Canal-Bayou Barataria Levee Project (original design) and all activities regulated under Section 404, with the exception of certain habitat enhancement projects which receive the approval of the Regional Administrator.

The recommended determination is based on a thorough site evaluation, coordination with representatives of affected landowners, consideration of information provided by other agencies and knowledgeable individuals, a review of the scientific literature, a review of the administrative activities of EPA, the federal court proceedings, and the results of a public participation program.

ADDITIONAL INFORMATION:

This document represents a summary of the findings from all the information reviewed in the administrative record. For further information contact: Environmental Protection Agency, Federal Activities Branch, 1201 Elm Street, Dallas, Texas 75270.

Date: August 30, 1985


Dick Whittington, P.E.
Regional Administrator

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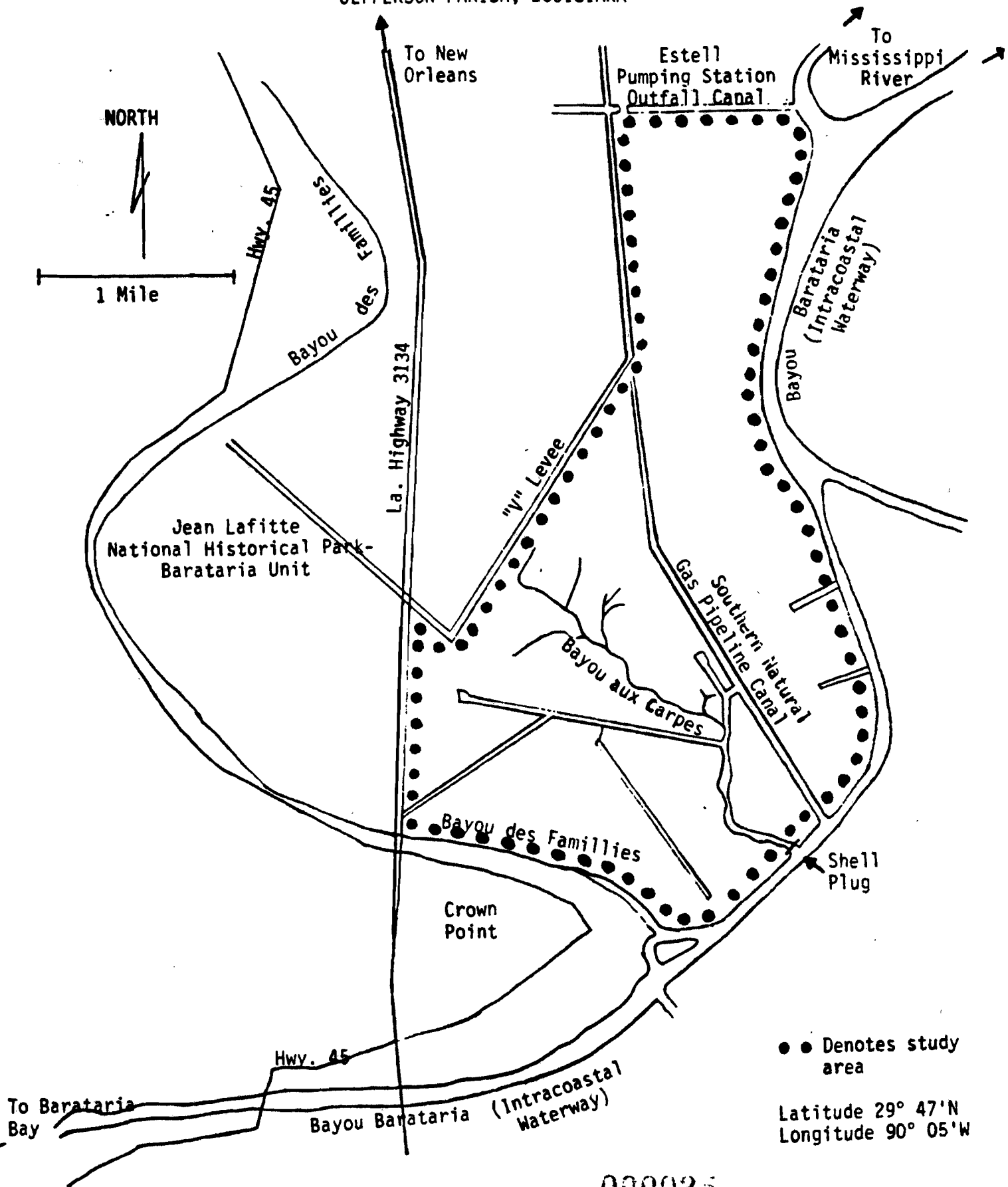
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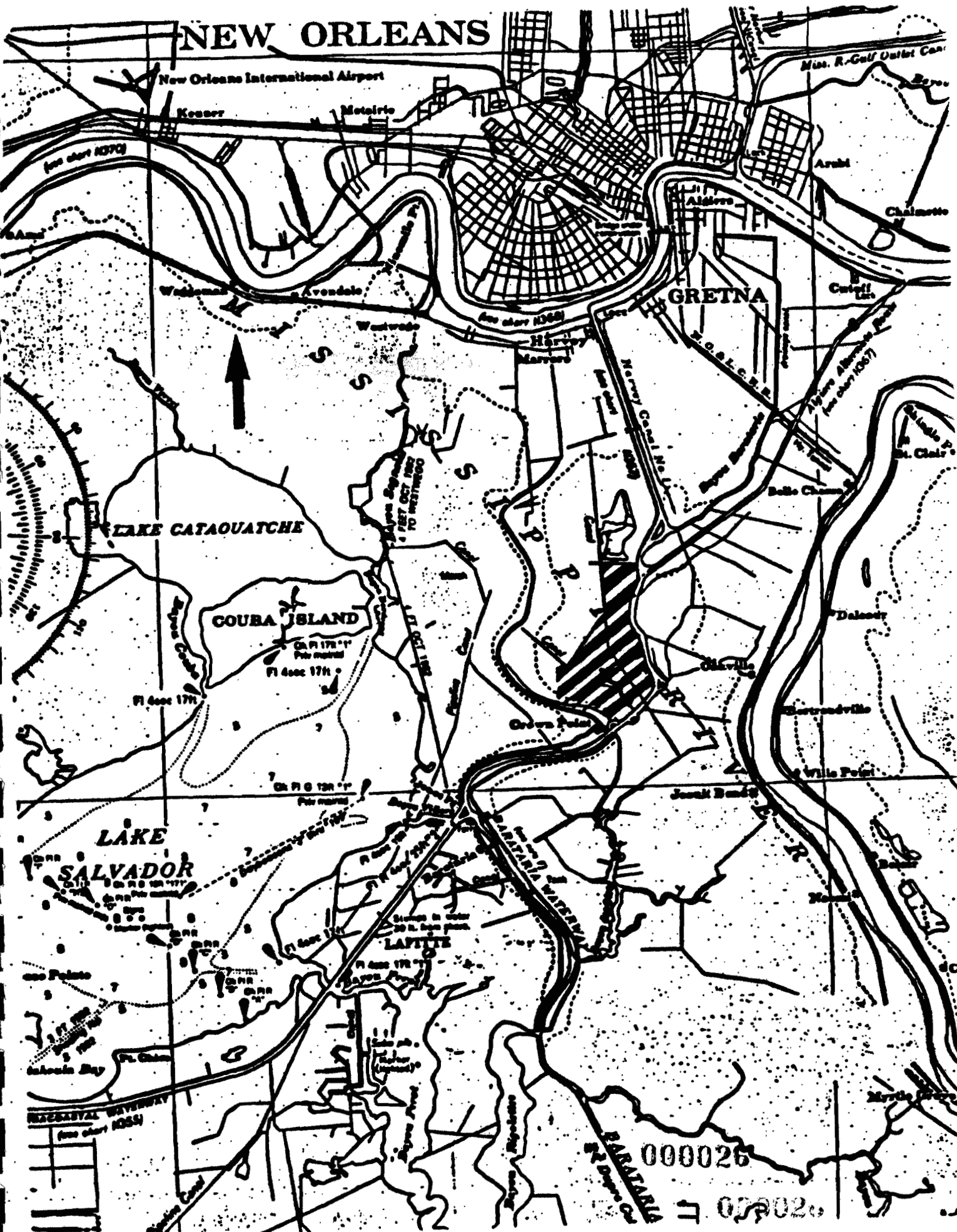
BAYOU AUX CARPES STUDY AREA
JEFFERSON PARISH, LOUISIANA



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NEW ORLEANS



New Orleans International Airport

Kenner

Metairie

Miss. R. Golf Outlet Can.

Arabi

Chalmette

GREYNA

LAKE CATAOUATCHE

COUBA ISLAND

LAKE SALVADOR

LAFITE

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**B. A HYDROLOGICAL, CHEMICAL, AND BIOLOGICAL
ASSESSMENT OF BAYOU AUX CARPES**

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**A HYDROLOGICAL, CHEMICAL, AND BIOLOGICAL ASSESSMENT OF
BAYOU AUX CARPES, NEW ORLEANS, LOUISIANA
JANUARY 1985**

**by
Environmental Protection Agency
Environmental Services Division
Ecological Support Branch
Athens, Georgia 30613**

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JUN 13 1985

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PROJECT PERSONNEL

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- Hoke S. Howard - Aquatic Biologist, Region IV, EPA
- Donald W. Lawhorn - Engineering Technician, Region IV, EPA
- Barbara Keeler - Biologist, Region VI, EPA

Project personnel wish to acknowledge the assistance of Sue Hawes, New Orleans District of U. S. Army Corps of Engineers, whose familiarity with the site was of great benefit.

*Authors

SUMMARY AND CONCLUSIONS

1. The Bayou Aux Carpes project area consists of approximately 3000 acres of wetlands comprised mainly of forested swamp and marshes. Although the project is bound on its perimeter by levees, the Southern Natural Gas Pipeline (SNGP) canal provides a direct hydrological connection between the site and the Barataria Intracoastal Waterway (ICW) and Barataria Bay. Navigation within the project area is provided by the SNGP canal, petroleum exploration canal, and bayou.
2. Wind appears to be the primary force effecting water levels in the project area and the Barataria Waterway. A diurnal tide range of 0.3 to 0.4 feet was recorded during the study. This range appears typical of the upper basin region of the Barataria Bay system. A rainfall event of 1.4 inches produced no discernible increase in water levels within the project waterways.
3. An average ground surface elevation of 1.24 feet National Geodetic Vertical Datum (NGVD) was determined from 22 survey observations within undisturbed swamp and marsh areas of the project site. During the study, the average depth of water inundating the marsh and swamp area was observed to be 0.3 feet. Surface elevation of the swamp and marsh water at most locations exceeded water level elevations in the Barataria Waterway and the SNGP canal. The relatively flat topography of the swamp/marsh areas and the broken berm line flanking a

majority of adjoining canals enhanced the capacity of the swamp to detain, store, and slowly release surface water to downstream systems.

4. The water storage capacity of the swamp was illustrated in the present study by the measured cyclic chloride concentration of swamp water discharged to the Barataria Waterway.
5. Dye tracer studies confirmed that water transport from Bayou Aux Carpes to the Barataria Waterway was rapid and directed towards Barataria Bay. Traced waters exiting the Bayou Aux Carpes site via the SNGP canal traveled downstream in the Barataria Waterway a distance of six miles in less than 24 hours.
6. During 1984, water levels in the Barataria Waterway exceeded the average swamp/marsh surface elevation of 1.24 feet NGVD at least 50 percent of the time. Water level elevations in the Barataria Waterway equaled or exceeded 1.24 feet NGVD between one and 26 days each month during 1984. The frequency at which water levels equaled or exceeded 1.24 feet NGVD were most pronounced during the period from May through October 1984 and appeared as a response to southerly wind directions. During 1984, the average annual water level in the Barataria Waterway was 10 to 14 percent below the 20-year mean; hence, the potential for the flooding of the Bayou Aux Carpes swamp is greater during an average water year.

7. The Bayou Aux Carpes project area is a fresh to weakly brackish aquatic environment. Surface water salinity of the swamp drainage ranged from 0.5 to 0.8 ppt with a soil water salinity measuring 1.5 ppt in a marsh area. Salinity of the Barataria Waterway was 0.1 ppt. Based upon this salinity regime, the source of the salinity would ultimately be the Barataria Bay estuary. Winds from the south during the summer could drive saline water from the estuary into Bayou Aux Carpes area where it is stored and metered back into the estuary during the winter with the assistance of northerly winds.
8. Sampling of canal habitat yielded 14 taxa of macroinvertebrates and four species of fish. Three estuarine species were included in the catch -- blue crab, fiddler crab, and bay anchovy. From the marsh/swamp habitat, 27 taxa of macroinvertebrates including blue crab and 6 species of fish were collected. Many of the crustaceans collected are important fish food items such as juvenile crayfish, grass shrimp, and amphipods.
9. With the rise and fall of water levels in the Bayou Aux Carpes site, a hydrological mechanism was available for the exchange of nutrients and organic matter with the Barataria Waterway. Measurements of dye dispersion from the site and nutrient exchange at the mouth of SNGP canal confirmed an export mechanism. The Bayou Aux Carpes area was shown to be a source of organic carbon and nitrogen (detritus) to the Barataria Waterway which leads to Barataria Bay.

10. Water from the Barataria Waterway contains urban runoff from the New Orleans area which is frequently introduced into the Bayou Aux Carpes system where the surface water is temporarily detained. With detention, heavy metals are deposited in the sediments and inorganic nitrogen ($\text{NO}_2\text{-NO}_3$) is biologically processed into other compounds including plant and animal matter which are then subject to export to downstream areas.
11. Results of this study confirm the earlier findings of the 1976 EPA assessment of Bayou Aux Carpes. The 1976 study concluded that Bayou Aux Carpes is a valuable and viable parcel of swamp and marsh in terms of production and export of organic matter, habitat for important fish and shellfish, storage of surface water, processing of nutrients. Therefore, the project area remains a functioning component of the Barataria Bay system.

INTRODUCTION

The Regional Administrator of EPA, Region 6, has initiated a 404(c) action on a wetland tract in Jefferson Parish, Louisiana, south of New Orleans. The purpose of this action is to preclude the loss or alteration of wetlands through the filling and/or forced drainage of approximately 3000 acres of marsh and forested swamp in the Bayou Aux Carpes area. The filling and forced drainage of such areas impairs and destroys several natural functions presently providing public benefits. With this particular project, loss of aquatic habitat for the production of fish, shellfish, fish food items, primary production, and water storage are some of the primary issues.

The Administrator for Region 6 requested personnel of the Environmental Services Division of Region 4 to assist Region 6 members in evaluating these issues in early 1976. At that time, a team of aquatic biologists and an environmental engineer assessed pertinent documents and conducted an inspection of the project area. This inspection produced findings indicating the value of the Bayou Aux Carpes swamp in terms of ecological functions (Appendix A). In 1984, the Environmental Services Division of Region 4 was requested to conduct a technical study to gather additional site specific facts regarding the chemical, biological, and physical character of the Bayou Aux Carpes swamp. The site study, initiated in mid-January 1985, had the following objectives:

- o Determine the kinds of fish, shellfish, and benthic macro-invertebrates associated with the marshes, forested swamp areas and adjoining canals.
- o Determine the water level dynamics associated with the Bayou Aux Carpes swamp, adjoining canals, and the Barataria Waterway (ICW) leading to Barataria Bay.
- o Evaluate the potential nutrient and detrital exchange between the Bayou Aux Carpes swamp, associated canals, and Barataria Bay.
- o Characterize the water and sediment quality associated with the Bayou Aux Carpes swamp and adjoining canals.

PROJECT AREA AND STUDY SITE

The project area of the Bayou Aux Carpes swamp measures approximately 3000 acres and is located south of New Orleans, Louisiana and is part of the Barataria Bay Basin (Figure 1). The area is irregularly shaped and is bounded to the east by the Barataria Waterway (ICW) and to the west by the Jean Lafitte National Park and the "V" levee-canal (Figure 2). The National Park is hydrologically connected to the Bayou Aux Carpes system via culverts under the Lafitte-Larose Highway (Day, 1984). Navigation to the interior of the study area is possible by way of the Southern Natural Gas Pipeline (SNGP) canal which connects with Bayou Aux Carpes and other canals created for petroleum exploration efforts.

Based upon inspection of the site by EPA personnel in 1976 and current aerial photography of the area, the Bayou Aux Carpes project area can be described as a diverse wetland composed of forest and shrub swamp, marshes, ponds, and open waterways. Bald cypress, tupelo-gum, green ash, and red maple are common upper story vegetation of the swamp while softstem bulrush, bulltongue, cattail, spikerush, and alligator-weed are typical of the marsh regions. Water hyacinth and duckweed characterize the floating vegetation of the Bayou and dredged canals.

Earlier work by Chabreck (1972) indicates that the Bayou Aux Carpes area to be part of the Barataria Basin hydrologic unit and is subject to slight tidal effects. Based upon his description of

vegetation and salinity for both surface and soil water, the Bayou Aux Carpes area appears primarily as a freshwater to intermediately brackish aquatic system.

Because of restricted accessibility, the present study focused on the areas of the Bayou Aux Carpes swamp associated with the SNGP canal and exploration canals. Location of stations for hydrographical, water quality and biological sampling are shown in Figures 3, 4, and 5, with station descriptions provided in Table 1.

METHODS AND RESULTS

Quality Assurance

Methodology involved in data gathering for this study followed EPA, Environmental Services Division Standard Operating Procedures (SOP) protocol.

Hydrographic Assessment

The hydrographic assessment included the determination of water level dynamics, water motion, and ground surface elevation.

The study of water level dynamics involved the placement of Stevens recorders within the project boundaries, in the east borrow ditch of the Lafitte-Larose Highway, at the mouth of the SNGP canal and on the ICW at the Lafitte-Larose Highway bridge (Figure 3). Additionally, water level records from gauging stations operated by the U. S. Army Corps of Engineers (COE) at the Algiers Lock, Barataria Waterway at Lafitte, and Barataria Waterway at Barataria

(Figure 1) were obtained for the current EPA period of study and for approximately the previous 20 years.

For the period of study, a recording rain gauge was installed in the Bayou (Figure 3). Wind direction and speed data for the study period were obtained from the New Orleans Moisant International Airport. Ground surface elevations of the marsh and swamp within the Bayou Aux Carpes area were determined by differential leveling between the water surfaces in the waterways and the marsh and swamp floor.

Water Level Responses

Water levels recorded in the Bayou Aux Carpes study site, and at the Algiers Lock (upstream of the site) and at Barataria (downstream of the site) were compared for the study period of 1/16-20/85 (Figure 6). By inspection, water levels at the three locations appeared to closely track each other. A small diurnal tide range of approximately 0.3 foot was evident in each record. Daily water level recordings for a one year period (January - December, 1984) were examined for the Barataria and Algiers gauging stations by comparing simultaneous 0800 hours observations (Figure 7. Mean water levels at the Algiers and Barataria stations were 1.28 and 1.24 feet NGVD (National Geodetic Vertical Datum), respectively. The similarity in water level dynamics was also evident in records spanning 17 to 22 years for the COE gauging stations (Table 2). From Table 2, a mean tidal range of 0.25 to 0.35 foot NGVD was derived from the difference between mean low and mean high

water levels calculated for the gauging records. The tidal range of 0.3 foot observed in the EPA study appeared typical of the long term records. Since tidal ranges are relatively small (about 0.3 foot), the effects of wind and rainfall on water level dynamics were also considered. Wind effects are particularly significant in shallow, open water bodies such as those associated with the Mississippi River estuarine system.

The effects of wind on water levels in the Barataria waterway and Bayou Aux Carpes were clearly evident during the study. In the afternoon of 1/16/85 a marked rise in water level occurred with a corresponding decrease following on 1/20/85 (Figure 6). Wind speed and direction data provided by the Moisant International Airport, New Orleans, depicted a relatively strong wind from the south with gusts to 24 knots on the afternoon of 1/16/85 and a strong wind from the north with gusts in excess of 30 knots on 1/20/85 (Figure 8). From these data, it is apparent that winds from the south effected a rise in water levels whereas winds from the north lead to a decrease in water levels.

During this same period, a rainfall gauge installed in Bayou Aux Carpes recorded a rainfall of 1.4 inches between the hours of 2200 on 1/16/85 and 0500 on 1/17/85 (Figure 9). The effects of rainfall on water levels in the Barataria Waterway and Bayou Aux Carpes were not apparent in the records shown in Figure 6. The record probably reflects the masking effects of wind. However, the rainfall effected a sharp rise in the water level recorded at

the Lafitte-Larose highway borrow ditch (Figure 10, see Figure 3 for recorder location). Since the borrow ditch receives roadside runoff and drainage from the Jean Lafitte National Historical Park, the water level increase was probably accentuated by storm runoff, i.e. water level rise was 0.6 feet following a 1.4 inch rainfall event. Drainage maps of the Lafitte-Larose Highway (Louisiana Department of Transportation) show several culverts under the highway connecting surface drainage of the Park to the Bayou Aux Carpes system.

Following the rain event, the water level in the borrow ditch slowly but steadily decreased. This pattern was unlike water level records for either the swamp or Barataria Waterway. For example, a water level recorder stationed in the swamp approximately 0.25 mile east of the recorder positioned in the borrow ditch (Figure 3) provided a water level record similar to the ICW records (Figure 11). The contrast between the swamp and borrow ditch hydrographs suggests, at least during the EPA study period, that water levels in the ditch were not responding simultaneously to hydrographic conditions in the Barataria Waterway.

Ground Surface Elevations

As previously reported, water level records for the ICW and Bayou Aux Carpes were nearly identical (Figures 6 and 7); hence, the recorded water levels at Algiers Lock and the Barataria gauges were used to adjust water levels in the Bayou Aux Carpes to NGVD. Ground surface elevations of the marsh/swamp within Bayou Aux

Carpes System were determined by differential leveling between the water surfaces in the canals and the marsh/swamp floor. Locations of the seven ground surface transects are shown on Figure 12. A total of 22 elevations were determined within the undisturbed marsh/swamp floor. Elevations ranged from 0.44 to 1.65 feet with a mean of 1.24 feet NGVD (Table 3).

The frequency of occurrence of water level elevations in the Barataria Waterway which can potentially flood into the marsh and swamp areas were determined for 1984. Water levels recorded each day at 0800 hours were plotted for the Algiers and Barataria water level gauges (Figure 13). As shown, the mean elevation of the marsh and swamp floor (1.24 ft. NGVD) was exceeded at least 50 percent of the time by water levels in the Barataria Waterway. Marsh-swamp elevations of 0.44 and 1.65 feet NGVD were exceeded 95 and 20 percent of the time by water levels in the waterway, respectively. Numerous breaks in the levees adjacent to the swamp and marshes including the unfilled areas at the head of the canals allow surface water to flow between the wetlands and adjacent waterways. Remnants of the original Bayou Aux Carpes waterway (Figure 2) was unleveed, thus allowing surface water to sheet flow to the adjoining wetlands. During the study period, depth of surface waters in the swamp averaged 0.3 foot (Table 3).

Water Circulation (Dye Tracer)

A dye tracer (Rhodamine WT) was released at 1200 hours on 1/17/85 in Bayou Aux Carpes at the rain gauge location (Figure 3).

Dye dispersion from the point of release was monitored by automatic samplers positioned near the mouth of the SNGP canal (Figure 3). The samplers were operated for a period of 36 hours with sample collections programmed at one-hour intervals. Samples were split with one portion measured with a fluorometer for dye concentrations and the other returned to the Athens Laboratory (EPA) for chloride analysis. In addition, a boat mounted flow-through fluorometer was used to monitor the travel of traced water within the project's navigable watercourses and in the Barataria Waterway.

Within 3.5 hours following release, the tracer was found at Station 10 near the mouth of the SNGP canal (Figure 14). The traced waters exited from the canal and into the Barataria Waterway on successive ebb tides. Dye concentrations increased through the ebbing phase of the tide. During the flood tide, water from the Barataria Waterway flooded into the SNGP canal resulting in a decrease in dye concentrations.

The traced waters from Bayou Aux Carpes moved rapidly downstream through the SNGP Canal and then into the Barataria Waterway (Figure 15). The dye path from the point of release tracked primarily to the SNGP Canal and then south to the Barataria Waterway and then towards Barataria Bay. Virtually no dye moved in a northerly direction along the SNGP canal nor did it disperse upstream of Station 6, the long east-west drill hole canal. The leading edge of the dye cloud entered the Barataria Waterway within 4.5 hours of

its release. After 21.5 hours, the traced waters had traveled downstream in the ICW to the community of Barataria (Figure 1), a distance of 31,000 feet or nearly 6 miles (Figure 15).

Chloride concentrations responded to tidal phase much in the manner depicted for the dye (Figure 14). At Station 10 near the mouth of the SNGP canal, chloride concentrations increased on the ebbing tide with a decrease occurring on the flooding phase. Swamp drainage appeared as the source of chlorides during the study period. Surface water from the Barataria Waterway (Station 11) contained the lowest chloride concentration of 49 mg/L. Chloride concentrations for other locations in the project area ranged from 250 to 430 mg/L (Table 4). Soil water collected from a screened well point driven to a depth of two feet in the marsh floor (Station 10a) yielded a chloride concentration of 800 mg/L or about 1.5 ppt salinity. Surface salinity of the swamp drainage ranged from about 0.5 to 0.8 ppt (Table 4). As discussed later, the ultimate source of the chlorides in the swamp drainage is presumably the estuary.

Water Chemistry (Nutrients)

The nutrient exchange regime of surface water exchanging between the Bayou Aux Carpes swamp and Barataria Waterway was sampled over a 36-hour period. Automatic samplers were positioned at the mouth of the SNGP Canal (Station 10) and programmed to collect samples at hourly intervals. In addition, surface water grab samples were collected from the Barataria Waterway and at other sites in the swamp and adjoining canals (Figure 4). All samples were preserved and returned to the Athens Laboratory (EPA) for analyses.

Organic carbon and organic nitrogen concentrations at the mouth of the SNGP Canal responded to tidal effects as described for the dye and chlorides observations. Concentrations increased on the ebbing tide and then decreased during the flooding phase (Figure 16). This trend suggests that the Bayou Aux Carpes system is a source of organic matter to the Barataria Waterway. The $\text{NO}_2\text{-NO}_3$ concentration regime at the mouth of the SNGP canal was reversed in terms of the tidal effects. Concentrations increased during the flooding phase and decreased when ebbing tides occurred (Figure 17). The observed relationship between tidal, organic nutrients and chloride concentrations indicates that with decreasing water levels in the ICW, flow at the mouth of SNGP Canal is driven primarily by swamp drainage. In contrast, the rising water in the Barataria Waterway provides the energy to disperse water from the Barataria Waterway to the canal.

Nutrient concentrations of surface water collected from the swamp, canals, and Barataria Waterway are shown in Table 5. Concentrations for ammonia (NH_3) and nitrite-nitrate ($\text{NO}_2\text{-NO}_3$) were greater in the Barataria Waterway than in the swamp or associated canals. Concentrations of $\text{NO}_2\text{-NO}_3$ were nearly 28 times greater in the Barataria Waterway compared to the marsh-swamp drainage (Figure 18). In contrast, higher levels of organic carbon (TOC) and organic nitrogen (Org. N) were associated with swamp drainage (Figure 18). Marsh-swamp drainage featured at least a two-fold increase in TOC and organic nitrogen concentrations compared to Barataria Waterway (ICW).

Sediments

Particle size and organic content of sediments are factors affecting the kinds and numbers of benthic macroinvertebrates dwelling in or upon the bottom. Bottom sediments also serve as a sink for many kinds of heavy metals and man-made compounds such as pesticides. To characterize these physical and chemical aspects, sediments were obtained from the bottom of selected stations in forested swamp, marshes, canals, and the Barataria Waterway. Samples analyzed for particle size, organic content, and heavy metals were collected as 10 cm bottom cores.

Results for priority pollutant pesticides and PCB analyses of sediment samples indicate all designated compounds examined were below the detection limits for the chemical procedure employed (Table 6).

Particle size composition of core samples from the Barataria Waterway and canals was predominately silt particles (0.0039 to 0.0625 mm in Figure 19). Total organic content of the core samples ranged from 12 to 20 percent, by dry weight. The sediment profiles for Station 2 (a forested swamp area) and Station 10a (a marsh area), were similar to those characterizing the canals and Barataria Waterway (Figure 20). Stations 7 and 8 (a marsh and swamp site, respectively) were in sharp contrast to other sites. Sediments were primarily comprised of coarser materials (identified as decomposing vegetation), 2 to 32 mm, with a total organic content of 64 to 67

percent (Figure 21). Sediments featuring an organic content exceeding 50 percent by dry weight are generally typical of peat substrate (Chabreck, 1972). Chabreck further indicates that sediments with less than 15 percent organic content tend to represent mainly mineral soils comprised primarily of silt, clay, and sand. Based upon these distinctions, the sediments (top 10 cm) associated with the Barataria Waterway and canals appear alluvial in origin. In this case the silt and clay particles originated elsewhere and were trapped by the stilling effects of the canals and wetlands.

The contrast in sediment profiles for the two swamp or marsh areas sampled appeared related to their hydrological connection to the canals. As indicated by the general station description (Table 1), Stations 2 and 10a were in the direct pathway of surface water exchanging between the canals and the wetlands via breaks in the berm line. Stations 7 and 8 were not proximate to breaks in the canal berm. The surface water exchange between the canals and wetlands was more characteristic of sheet flow. By the time the surface water originating from the canals reached the more interior sites, its silt load was probably relieved via the deposition process.

The ability of canals and the swamp/marsh habitat to trap finely divided particles was also evident in the heavy metals concentrations determined for the sediments (Figure 28). The ICW appeared to retain greater concentrations of zinc compared to the swamp and marsh areas. Copper, lead, and iron, concentrations

appear uniformly distributed between the swamp, marsh, canal, and Barataria Waterway (ICW). This distribution pattern indicates the capacity of the marsh/swamp system to trap these heavy metals typically associated with urban runoff.

Biological

Qualitative sampling for benthic macroinvertebrates was conducted in Bayou Aux Carpes marsh and forested swamp environs (Stations 2, 7, 8 and 10a). Various methods, such as standard biological dip nets and drift nets (.5 mm mesh) and hand sorting from available substrates including aquatic plants, stumps, rocks and debris were employed.

To sample nektonic animals in the canals, a channel net was stretched across the canal segment leading from the SNGP canal to Station 4 and anchored to stakes deeply driven into the adjoining banks. The net was constructed of 1 mm nylon mesh with a 5/16-inch chain secured to the foot line of the net. It measured 8 x 50 feet with an 8 x 8 x 8 feet center bag. The canal channel measured approximately 60 to 70 feet in width, hence, the net when in place only partially blocked the canal. The net was fished for approximately four hours on an ebbing tide. Specimens collected from the net were stored in widemouth plastic containers with 90 percent ethanol as a preservative and returned to the Athens Laboratory for identification to the lowest possible taxa.

Swamp and Marsh Biota

Sampling of benthic macroinvertebrates indicated a relatively low level of species richness associated with the swamp and marsh habitat (Table 7). Crustaceans and odonates appeared as the predominate groups of taxa observed in the samples. Nine and 14 taxa of macroinvertebrates were found associated with the swamp areas sampled at Stations 2 and 7, respectively. Five of these taxa were common to both stations which included two kinds of amphipods, aquatic snails, and juvenile crayfish. Aside from the difference in number of taxa (9 versus 14), hydrology and substrate quality were also different.

Station 7, when compared to Station 2, was more of an interior site in the swamp where the water was deeper (3 to 4 inches) and its movement characteristic of sheet flow. Station 2 was characterized by a more vigorous flow regime because of its closer proximity to a primary surface water connection between the canal and swamp. The sediment of the interior swamp site (Station 7) was characterized as peat substrate compared to a more finely divided substrate of silt and sand at Station 2.

Samples from two marsh sites (Stations 8 and 10a) each yielded nine taxa of benthic macroinvertebrates (Table 7). As in the case of the two swamp stations sampled, the quality of substrate and surface water movement were also distinctly different. Three species of amphipods and one species of snail were common to both marsh areas. Grass shrimp, P. kadiakensis, and blue crab, C. sapidies,

were found associated with the small drainage cuts extending from the SNGP canal into the marsh at Station 10a. The presence of blue crabs, a juvenile specimen, reflects the hydrological and biological interaction between the project area and the estuary.

In addition to the benthic macroinvertebrates collected in the swamp and marsh habitat, several species of fish were found associated with these areas (Table 8). Livebearers, such as mosquitofish, least killifish, and sailfin molly, were observed. Mosquitofish appeared as the most abundant species. In addition, spotted sunfish, banded pygmy sunfish, and one species of killifish were collected. Except possibly for the banded topminnow, the fish collected are considered euryhaline species with mosquitofish being common to tidal swamps and marshes (Odum, 1984).

Canal Biota

Sampling of canal biota was limited to a single blocknet set. Because the net only partially blocked the canal channel, the data collected by this means must be viewed in qualitative terms.

The blocknet catch yielded 14 taxa of macroinvertebrates and 4 taxa of fish (Tables 7 and 8). Eight invertebrate taxa were common to the macroinvertebrate communities associated with the marsh and swamp environment. In addition to the blue crab, a second estuarine crab (Uca sp.) was captured by the channel net.

The fish species were represented by juvenile specimens and included bay anchovy, gizzard shad, sunfish, and least killifish

(Table 8). The bay anchovy is an estuarine species which generally migrates to tidal freshwater in the early spring to feed and then returns to the estuary to spawn in late spring. Larvae of this species move upstream to weakly brackish and freshwater tidal nursery areas in the summer (Odum, 1984).

DISCUSSION

Presently, levees span virtually the entire perimeter of the Bayou Aux Carpes project area. The Southern Natural Gas Pipeline (SNGP) canal provides the primary hydrological connection between the swamp and the Barataria Waterway (ICW) and ultimately Barataria Bay. With construction and maintenance of the SNGP canal and associated drill hole canals, dredged materials were spoiled along the canal banks thus forming berms which in some areas measured several feet high. Numerous breaks in the berm line, especially at the end of the canals, provide a pathway for surface water to exchange between the swamp marshes and canals. Determining the potential for exchange of water between these systems was one of the primary objectives of the hydrological assessment.

The mean water level for the Barataria Waterway in the vicinity of the project area was 1.38 to 1.45 feet NGVD. Ground surface elevations of swamp and marsh areas surveyed averaged 1.24 feet NGVD. Accordingly, the potential for the flooding of the Bayou Aux Carpes by rising water in the Barataria Waterway appears to occur at least 50 percent of the time (Figure 13). Furthermore, the frequency of water levels at or above 1.24 feet NGVD in the Barataria Waterway appeared strongly seasonal (Figure 23).

The 1984 water level record for the Barataria Waterway (ICW) reveals three aspects of the flooding regime. First, the 1984 record depicts the average monthly water level as generally peaking during the period of May through October. Since the average ground elevation of the Bayou Aux Carpes swamp was 1.24 feet NGVD, water stages attaining or exceeding this elevation could initiate flooding of the swamp. It is only coincidental that the annual monthly water levels in 1984 averaged 1.24 feet, which is identical to the average surface elevation of the swamp in the study area transects. Secondly, the 1984 annual water level average of 1.24 feet NGVD in the Barataria Waterway was about 0.14 to 0.21 of a foot less than the 20-year average reported in Table 2, i.e., about 10 to 14 percent less in amplitude than the 20-year average. Finally, the lower graph in Figure 23 shows that flooding of the swamp could have occurred in each month of the 1984 water year and possibly even daily as suggested in the case of October during an average or above average water year.

The primary factor controlling the water level appeared to be wind. Short term effects of wind were clearly apparent during this study. Winds from the south increased water levels; whereas, winds from the north effected a measured decrease in water levels (Figures 6 and 8).

Historically, winds from the south prevail during the summer while winds from the north dominate during the winter (Figure 24). Rain events do not appear to effect water levels as readily as the wind (Figure 25). As indicated by Day (1984), winds from the south

provide the necessary energy to drive estuarine waters into the Bayou Aux Carpes region of the Barataria Basin, which would account for the weakly brackish character of the waters draining from the swamp during this study. The capacity of the Bayou Aux Carpes swamp to detain surface waters was evident in the chloride data reported for this study. Chloride concentrations increased with ebb flows from the swamp and decreased when the direction of flow reversed and originated from the Barataria Waterway (Figure 14).

The relatively flat topography of the swamp, in combination with the broken berm line of the canals, undoubtedly served as factors enhancing the capacity of the swamp to detain surface waters and effect its slow release to downstream systems. The average depth of water over the swamp and marsh floor was 0.3 foot (Table 3). This value when added to the average ground surface elevation of the swamp resulted in an average water level elevation of 1.54 feet NGVD. This elevation was above the maximum water level height recorded in the ICW and study canals (Figure 6). The water stored in the forested swamp would seek breaks in the berm line where it's gradually discharged into the canals and ICW. Such a hydraulic gradient would explain the observed net movement of organic carbon, organic nitrogen, chlorides, and dye to the Barataria Waterway.

The seasonal flooding and storage regime of the Bayou Aux Carpes area provides numerous and unique benefits in terms of nutrient processing, primary and secondary production, flood control, salinity control, and as a nursery habitat for freshwater and estuarine fish and shellfish.

The hydrological connection between Bayou Aux Carpes and the Barataria Waterway and the capacity of the Bayou system to detain surface water combined to buffer effects of urban runoff from the New Orleans area on downstream regions like Barataria Bay. Results of the sediment analyses demonstrate the function of Bayou Aux Carpes as a mechanism for trapping finely divided materials thus interrupting their transport to the estuary. Heavy metals, whether absorbed to silt, clays, organic matter, or precipitated as metallic sulfides, are deposited in the sediments.

By detaining the surface water particularly associated with summer flooding, nutrient cycling in the swamp is enhanced. Detention increases the contact time of overflow water with the forest floor of the swamp which is the principal site of denitrification processes and nutrient uptake by rooted vegetation (Brinson, 1981). The timing of the annual flooding regime coincides with the primary growth period of the swamp plant community in southern Louisiana freshwater swamps (Conner and Day, 1976).

The denitrification process ($\text{NO}_2\text{-NO}_3$ to N_2) is an efficient, rapid, and important function in forested swamps as well as tidal marshes (Brinson, 1981; EPA, 1984; and Brinson, et al., 1984). Denitrification is an anaerobic process involving specialized bacteria which utilize the nitrogen bound oxygen (NO_3) as an energy source. In this manner, the NO_3 is reduced to nitrogen gas (N_2) as the bacteria assimilate organic matter. Thus, the decomposition of organic matter proceeds in the absence of dissolved oxygen and the

nitrite-nitrate load of the overflow water is diminished. At virtually all marsh and swamp stations sampled, disturbed sediments yielded the odor of hydrogen sulfide, which is characteristic of a reducing environment.

The biological cycling of inorganic nitrogen ($\text{NO}_2\text{-NO}_3$) was evident in the Bayou Aux Carpes swamp. The $\text{NO}_2\text{-NO}_3$ concentration gradient decreased from sampling points in the Barataria Waterway to stations in the forested swamp and marshes (Figure 18). In this context, the Barataria Waterway emerges as a primary source of $\text{NO}_2\text{-NO}_3$ and the Bayou Aux Carpes swamp a principal area for its assimilation into other nitrogen forms such as animal or plant protein. Accordingly, the elevated concentrations of organic nitrogen in the swamp drainages as compared to those in the Barataria Waterway is not surprising (Figure 18).

With the rise and fall of water levels in the swamp, a hydrological mechanism is established for the exchange of nutrients between the swamp and Barataria Waterway. The export of these materials can be frequent (Figure 23). The lower graph of Figure 29 indicates the number of days each month in 1984 when the water level in the ICW equaled or exceeded the average ground elevation of the swamp and marsh. For each day that the water level in the ICW falls below 1.24 feet NGVD, a net drainage of surface water from the swamp to the Barataria Waterway is possible as demonstrated in this study. Results of the dye dispersion measurements confirmed the net movement of surface waters was from the Bayou Aux Carpes

swamp to the Barataria Waterway and downstream towards the estuary. Although the exchange of organic matter between the swamp and Barataria Waterway was not quantified in terms of loadings (tons/year), net export of organic nitrogen and total organic carbon (TOC) from the Bayou to the Barataria Waterway was evident. Concentration of dye, chlorides, organic nitrogen, and TOC increased at the mouth of the SNGP canal during the ebb phase of the tide (Figures 14, 16, and 17). The concentration gradient depicted in Figure 18 for TOC and organic nitrogen indicates the swamp and marshes as the principal source of organic matter in the export regime.

In terms of annual export of organic carbon and nitrogen from a forest swamp such as Bayou Aux Carpes, the work of Day, et al. (1977) provides a point of reference for judging the potential of the export regime in terms of mass loading from forested wetlands. These investigators conducted a 14-month study of net production and export of nutrients from a swamp forest in the upper drainage basin of the Barataria Bay estuary. Annually, the 770 km² swamp exported 8016, 1047, and 154 metric tons of organic carbon, nitrogen, and phosphorus, respectively, to the estuary. The hydrological regime of the swamp studied by Day, et al. (1977) was somewhat different from the Bayou Aux Carpes area. Both were subject to seasonal flooding; however, rainfall was the principal source of surface drainage in the swamp studied by Day, et al. (1977). For the Bayou Aux Carpes area, surface water drainage was primarily controlled by wind; rain and tide were secondary influences.

A source of organic matter (detritus) for export from the swamp would be its forest and marsh community of plants. Since the Bayou Aux Carpes site is a relatively typical cypress-tupelo swamp in terms of vegetational characteristics and seasonal flooding, its annual primary production would probably be similar to the swamp studied by Conner and Day (1976). These authors reported total primary production for the seasonally flooded Louisiana swamp at 1,574 g/m²/yr at a bottomland hardwood site and 1,140 g/m²/yr at a cypress-tupelo site. The net primary production in forested swamps is generally greater in seasonally flooded systems (Brown, et al., 1979).

The present study demonstrated a hydrological connection between the Bayou Aux Carpes swamp and the Barataria estuary. The pathway between the estuary and swamp appears operational each month of the year at least in the 1984 water year; thus, providing a route for the exchange of nutrients and aquatic life between the swamp and estuary.

Day (1984) provides insight to the seasonal migratory patterns of fish and shellfish in the Barataria Bay and its associated freshwater basins. He identifies the more traditionally reported migratory patterns of estuarine species using the freshwater regions of an estuarine basin as nursery habitat. He documents the presence of bay anchovy, sheepshead minnow, spot, striped mullet, tidewater silverside, and lady fish in the vicinity of the Jean Lafitte National Historical Park which is part of the Bayou Aux Carpes swamp. Hawes (1984) expanded this list of estuarine species for

Bayou Aux Carpes to include both juvenile and adult blue crab. The present study confirmed continual use of the Bayou Aux Carpes by estuarine species (Tables 7 and 8). Juvenile forms of estuarine crabs and bay anchovies were found in the mid-January sampling.

From Day (1984), Hawes (1984), and the present study, at least 15 species of freshwater fishes are reported to be associated with the Bayou Aux Carpes drainage area. Many of these species such as channel and blue catfish, sunfish, and bass, are recognized as important to both commercial and sport fisheries. Day (1984) further elaborated on the potential for a number of freshwater species to seasonally expand their territory in the winter. As he explains and documents, adult and juvenile forms of some freshwater species move from the traditional freshwater regions towards the Gulf in the fall and early winter where they replace marine species immigrating from the estuary to the Gulf. As summer approaches, salinity and temperature increase and the freshwater forms retreat back to the upper freshwater zones of the basin. This cycle would appear particularly significant in terms of assigning a fishery resource value to the Bayou Aux Carpes area. The assessment work of Day (1984) clearly indicates that the potential benefits of fishery production can extend well beyond the geographical boundaries used to describe Bayou Aux Carpes.

For the Bayou Aux Carpes project site, the benthic macroinvertebrate data indicated a relatively restricted community in terms of species richness (Table 7). For the two marsh stations and one

site in the forested swamp, only nine taxa were observed. However, many of the taxa found can tolerate a wide range of environmental conditions including low concentrations of dissolved oxygen and salinity. For several reasons, the relatively low diversity of the community is not surprising. As explained by Odum (1984), the relatively simple structure of the benthic macroinvertebrate community in a tidal freshwater system can be linked to a lack of diverse habitat. Non-tidal systems tend to yield a substantially more diverse community of benthic macroinvertebrates than a tidally effected system. The chloride data gathered in this study coupled with the findings of Chabreck (1972), indicate that the Bayou Aux Carpes site is seasonally brackish which would favor the survival of euryhaline species and impair the success of pure freshwater forms. Several of the taxa found in the Bayou Aux Carpes system can tolerate both fresh and saline environments. Although the benthic community may be represented by relatively few taxa (a total of 27), many of the taxa are important processors of organic matter and fish food items including crayfish, grass shrimp, and other crustaceans such as amphipods (Hyaella azteca and Gammarus sp.).

In the findings of the 1976 assessment by EPA personnel, Barataria Bay was described as the singly most productive estuarine area along the Louisiana coast (Appendix A). Also indicated was the fact that Louisiana estuaries owe their high level of productivity to the extensive system of marshes and swamps of the upper basins. These upper basin regions of swamps and marshes provide

the drainage necessary to maintain the broad, stable brackish zones in the estuary. The Bayou Aux Carpes system is one of these upper basin swamps draining to Barataria Bay.

The results of this study corroborate the findings of the EPA assessment in 1976 and the later assessment by Day (1984). Despite the present alterations of the swamp, mainly the presence of levees and canals, the Bayou Aux Carpes area provides local and regional benefits in terms of water storage and release, habitat for the production and growth of freshwater and estuarine fish and shellfish, nutrient processing, and a source of organic matter for export to Barataria Bay.

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Table 1. Station Descriptions, Bayou Aux Carpes Study,
Louisiana, January 1985

Barataria Waterway (ICW):

- Station 11 -- located approximately 100 yards from north shore in Barataria Waterway; soft, silty substrate; depth of 12-14 feet.

Canals:

- Station 3 -- mid-channel, located approximately 50 yards from head of short drill canal; silty substrate; bottom depth of 6-7 feet; hyacinths (Eichornia crassipes) at head of canal; berm vegetation consisted of red maple (Acer rubrum), mainly sweetgum (Liquidambar styraciflua) and wax myrtle (Myrica cerifera).
- Station 4 -- mid-channel, about 200 yards north of original Bayou Aux Carpes waterway; silty substrate; bottom depth of 6 feet; macrophytes along shore consists of alligatorweed (Alternanthera philoxeroides), bulltongue (Sagittaria falcata), pennywort (Hydrocotyl).
- Station 9 -- mid-channel, northernmost station in SNGP canal; approximately mid-point of canal length; soft, silty substrate; bottom depth of 5-6 feet; berm vegetation consisted of mainly red maple (Acer rubrum), willow (Salix), sweetgum (Liquidambar styraciflua), wax myrtle (Myrica cerifera), elderberry (Sambucus).
- Station 10 -- mid-channel, approximately 50 yards upstream from mouth of SNGP canal; soft, silty substrate; bottom depth of 4-5 feet; berm vegetation consisted of mainly willow (Salix), elderberry (Sambucus), water oak (Quercus nigra).

Marsh:

- Station 8 -- Marsh area, open canopied, located off west side of SNGP canal ($\approx 1/4$ mile from canal mouth); substrate appeared to be rich in organic matter (decayed and partially decomposed vegetative material); depth of water overlying substrate was generally less than one inch; most macrophytic vegetation was dead at time of study except for some Hydrocotyl.
- Station 10a -- Marsh area east of Station 10; station has a break in berm and egress and ingress of water was noted during the study period; most marsh vegetation was dead at the time of the study except for Hydrocotyl; substrate composition in the drainage cut appeared to be fine organic matter overlying fine sand; water depth in the marsh was approximately 1-2 inches while the drainage cut was approximately 10-12 inches.

Table 1 (Continued)

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Forested Swamp:

- Station 1 -- Located in forested swamp 50 yards off western end of shorter drill canal; station was located in drainage cut which emptied into the drill canal; flow between swamp and drill canal was evident during the study; vegetative community consisted of cypress, water tupelo with understory of lizard's tail (Saururus cernuus), bulltongue (Sagittaria falcata), coontail (Ceratophyllum demersum), water depth of approximately one foot; substrate appeared to be composed of fine silt overlying fine sand.
- Station 2 -- Located in forested swamp 50 yards off eastern end of shorter drill canal; station was located in drainage area which had flow emptying to the drill canal during the study period; vegetation same as described for Station 1; water depth was approximately one foot; substrate appeared to be fine silt overlying fine sand.
- Station 5a -- Located in drainage cut at end of longest drill canal; forested swamp composed of cypress and water tupelo with an understory of bulltongue, lizard's tail; water depth was approximately one foot; substrate appeared to be fine silt and sand.
- Station 9a -- Located in forested swamp, east of Station 9 which is approximately one mile from the mouth of the SNGP canal; vegetation consisted of mainly cypress, water tupelo; depth of water approximately 3/4 - 1 inch; substrate appeared to be high in organic content, especially decaying or partially decomposed vegetation.
- Station 7 -- Located in forested swamp off west side of SNGP canal (approximately 1/2 mile from canal mouth); cypress, water tupelo, red maple were predominant trees; understory vegetation consisted of bulltongue (Sagittaria falcata), banana lily (Nymphoides aquatica) and lizard's tail; water depth of 6 inches, substrate appeared to contain large amounts of decomposing organic matter.

TABLE 2
WATER LEVEL SUMMARY (FT - NGVD)
BARATARIA WATERWAY

| | <u>ICW at¹ Algiers Lock</u> | <u>Bayou² Barataria at Barataria</u> | <u>Bayou³ Barataria at Lafitte</u> |
|-------------------------------|--|---|---|
| Mean Annual Extreme High | 3.07 | 2.92 | 2.94 |
| Mean High | 1.55 | 1.57 | 1.60 |
| Mean Annual Extreme Low | -0.10 | 0.23 | -0.05 |
| Mean Low | 1.20 | 1.32 | 1.25 |
| Mean Water Level ⁴ | 1.38 | 1.45 | 1.43 |
| Mean Tide Range ⁵ | 0.35 | 0.25 | 0.35 |

Date Source: COE

1 - 1958 through 1980

2 - 1962 through 1980

3 - 1963 through 1980

4 - Based upon average of mean high and mean low stage

5 - Based upon difference of mean high and mean low stage

TABLE 3
GROUND AND WATER SURFACE ELEVATIONS (FT - NGVD)
BAYOU AUX CARPES
JANUARY 1985

| <u>Transect</u> | <u>Swamp/Marsh Left</u> | | <u>Swamp/Marsh Right</u> | |
|-----------------|-------------------------|--------------|--------------------------|--------------|
| | <u>Ground</u> | <u>Water</u> | <u>Ground</u> | <u>Water</u> |
| A | 1.53 | 1.60 | 1.60 | 1.63 |
| | 1.27 | 1.60 | 1.65 | 1.67 |
| | | | 1.61 | 1.67 |
| B | 1.49 | --* | 1.28 | 1.73 |
| | 1.54 | 1.59 | 1.27 | 1.73 |
| C | 1.05 | 1.53 | 1.02 | 1.65 |
| | 1.00 | 1.54 | 1.12 | 1.69 |
| D | | | 0.44 | 0.97 |
| | | | 1.04 | --* |
| E | | | 1.32 | --* |
| | | | 0.66 | 1.00 |
| F | 1.60 | 1.80 | 1.19 | 1.99 |
| | | | 1.56 | --* |
| G | 1.51 | --* | | |
| | 0.57 | 1.42 | | |

Total of 22 Ground Observations

Maximum 1.65
Mean 1.24
Minimum 0.44

Total of 17 Water Observation

Maximum 1.80
Mean 1.54
Minimum 0.00

*Water level below ground surface

000069

000069

TABLE 4
WATER CHEMISTRY-CHLORIDES (mg/L) and SALINITY (ppt)
BAYOU AUX CARPES
JANUARY 1985

| STATION | DATE | TIME | CL | STATION | DATE | TIME | CL | Sal (ppt) |
|---------|------|------|-----|---------|------|------|-----|-----------|
| 10 | 1/17 | 1045 | 130 | 2 | 1/20 | 1200 | 250 | 0.5 |
| | | 1145 | 140 | 5 | 1/23 | 0800 | 260 | 0.5 |
| | | 1345 | 170 | 7 | 1/20 | 1230 | 220 | 0.4 |
| | | 1445 | 180 | 9 | 1/20 | 0800 | 430 | 0.8 |
| | | 1545 | 190 | 10a | 1/20 | 1330 | 300 | 0.6 |
| | | 1645 | 210 | 10 soil | 1/19 | 1535 | 800 | 1.5 |
| | | 1745 | 220 | 11 | 1/20 | 1400 | 49 | 0.1 |
| | | 1845 | 240 | | | | | |
| | | 1945 | 240 | | | | | |
| | | 2045 | 250 | | | | | |
| | | 2145 | 210 | | | | | |
| | | 2245 | 110 | | | | | |
| | | 2345 | 110 | | | | | |
| | 1/18 | 0045 | 130 | | | | | |
| | | 0295 | 70 | | | | | |
| | | 0345 | 70 | | | | | |
| | | 1330 | 280 | | | | | |
| | | 1430 | 290 | | | | | |
| | | 1530 | 300 | | | | | |
| | | 1630 | 290 | | | | | |
| | | 1730 | 220 | | | | | |
| | | 1830 | 100 | | | | | |
| | | 1930 | 110 | | | | | |
| | 1/19 | 2030 | 250 | | | | | |
| | | 2130 | 290 | | | | | |
| | | 2230 | 260 | | | | | |
| | | 2330 | 150 | | | | | |
| | | 0030 | 140 | | | | | |
| | | 0130 | 70 | | | | | |
| | | 0230 | 54 | | | | | |
| | | 0330 | 51 | | | | | |
| | | 0430 | 52 | | | | | |
| | | 0530 | 54 | | | | | |
| | | 0630 | 65 | | | | | |
| | | 0730 | 77 | | | | | |
| | | 0830 | 130 | | | | | |
| | | 0930 | 200 | | | | | |

TABLE 5
WATER CHEMISTRY (mg/L)
BAYOU AUX CARPES
JANUARY 1985

| STATION | DATE | TIME | NH ₃ -N | NO ₂ -NO ₃ -N | Org. N | T-P | TOC |
|---------|------|------|--------------------|-------------------------------------|--------|------|-----|
| 1 | 1/17 | 1100 | 0.22 | <0.05 | 0.78 | 0.11 | 14 |
| 1 | 1/18 | 1205 | 0.33 | <0.05 | 0.87 | 0.11 | 14 |
| 1 | 1/19 | 1415 | 0.50 | <0.05 | 0.90 | 0.14 | 17 |
| 2 | 1/17 | 1100 | 0.07 | <0.05 | 0.93 | 0.10 | 12 |
| 2 | 1/18 | 1210 | 0.16 | <0.05 | 0.79 | 0.10 | 15 |
| 2 | 1/19 | 1410 | 0.37 | <0.05 | 1.23 | 0.15 | 19 |
| 3 | 1/17 | 1115 | 0.50 | 0.76 | 0.50 | 0.36 | 11 |
| 3 | 1/18 | 1200 | 0.26 | 0.65 | 0.72 | 0.34 | 12 |
| 3 | 1/19 | 1405 | 0.24 | 0.57 | 0.68 | 0.34 | 12 |
| 4 | 1/17 | 1120 | 0.20 | 0.94 | 1.00 | 0.38 | 11 |
| 4 | 1/18 | 1155 | 0.26 | 0.35 | 0.84 | 0.37 | 15 |
| 4 | 1/19 | 1400 | 0.14 | 0.25 | 0.84 | 0.36 | 14 |
| 5 | 1/17 | 1640 | 0.18 | <0.05 | 0.60 | 0.22 | 15 |
| 5 | 1/18 | 1135 | <0.05 | <0.05 | 0.80 | 0.16 | 14 |
| 5 | 1/19 | 1420 | 0.09 | <0.05 | 0.76 | 0.20 | 15 |
| 5-A | 1/17 | 1135 | <0.05 | <0.05 | 0.72 | 0.14 | 14 |
| 5-A | 1/18 | 1135 | 0.12 | <0.05 | 0.80 | 0.14 | 14 |
| 5-A | 1/19 | 1430 | 0.55 | <0.05 | 0.25 | 0.18 | 15 |
| 6 | 1/17 | 1206 | 0.14 | 0.35 | 0.96 | 0.34 | 15 |
| 6 | 1/18 | 1150 | 0.18 | 0.16 | 0.82 | 0.33 | 15 |
| 6 | 1/19 | 1500 | 0.09 | 0.24 | 0.90 | 0.33 | 14 |
| 7 | 1/17 | 1315 | 0.12 | <0.05 | 3.58 | 0.37 | 44 |
| 7 | 1/18 | 1230 | 0.12 | <0.05 | 1.58 | 0.14 | 22 |
| 7 | 1/19 | 1335 | 0.08 | <0.05 | 0.92 | 0.13 | 21 |
| 9 | 1/17 | 1300 | 0.23 | 0.24 | 1.07 | 0.30 | 15 |
| 9 | 1/18 | 1215 | 0.22 | 0.14 | 1.08 | 0.20 | 21 |
| 9 | 1/19 | 1350 | 0.19 | 0.09 | 0.91 | 0.18 | 18 |
| 10 | 1/17 | 1330 | 0.20 | <0.05 | 1.20 | 0.64 | 11 |
| 10 | 1/18 | 1315 | 0.08 | <0.05 | 1.12 | 0.50 | 13 |
| 10 | 1/19 | 1300 | 0.10 | <0.05 | 0.40 | 0.26 | 12 |
| 11 | 1/17 | 1330 | 0.62 | 1.4 | 0.48 | 0.56 | 8.4 |
| 11 | 1/18 | 1320 | 0.63 | 1.4 | 0.17 | 0.56 | 8.0 |

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TABLE 5 (continued)

| STATION | DATE | TIME | NH ₃ -N | NO ₂ -NO ₃ -N | Org. N | T-P | TOC |
|---------|------|------|--------------------|-------------------------------------|--------|------|------|
| 10 | 1/17 | 1040 | 0.19 | 1.1 | 0.71 | 0.48 | 14 |
| | | 1140 | 0.19 | 1.2 | 0.72 | 0.43 | 12 |
| | | 1240 | 0.19 | 0.99 | 0.72 | 0.36 | 11 |
| | | 1340 | 0.19 | 0.94 | 0.80 | 0.39 | 12 |
| | | 1440 | 0.20 | 0.82 | 0.80 | 0.38 | 13 |
| | | 1540 | 0.20 | 0.74 | 0.97 | 0.42 | 13 |
| | | 1640 | 0.20 | 0.65 | 1.10 | 0.41 | 14 |
| | | 1740 | 0.20 | 0.60 | 0.90 | 0.34 | 13 |
| | 1/18 | 2340 | 0.46 | 1.0 | 0.74 | 0.50 | 12 |
| | | 0040 | 0.43 | 0.97 | 0.87 | 0.53 | 11 |
| | | 0140 | 0.50 | 1.1 | 0.90 | 0.55 | 10 |
| | | 0240 | 0.60 | 1.3 | 0.80 | 0.30 | 9 |
| | | 0340 | 0.60 | 1.3 | 0.80 | 0.56 | 8.3 |
| | | 0440 | 0.62 | 1.2 | 0.68 | 0.56 | 8.6 |
| | | 0540 | 0.55 | 1.2 | 0.85 | 0.52 | 9 |
| | | 0640 | 0.36 | 0.92 | 0.84 | 0.46 | 12 |
| | | 0740 | 0.21 | 0.58 | 0.89 | 0.36 | 14 |
| | | 0840 | 0.43 | 0.94 | 0.87 | 0.48 | 11.5 |
| | | 0940 | 0.18 | 0.50 | 0.92 | 0.40 | 16 |
| | | 1040 | 0.17 | 0.47 | 0.93 | 0.34 | 15 |
| | | 1300 | 0.22 | 0.43 | 0.88 | 0.34 | 17 |
| | | 1400 | 0.13 | 0.39 | 1.67 | 0.80 | 23 |
| | | 1500 | 0.16 | 0.36 | 0.94 | 0.32 | 16 |
| | | 1600 | 0.13 | 0.38 | 0.85 | 0.35 | 14 |
| | | 1700 | 0.38 | 0.89 | 0.82 | 0.42 | 11 |
| | | 1900 | 0.45 | 1.0 | 0.75 | 0.5 | 8.7 |
| | | 2000 | 0.24 | 0.58 | 0.96 | 0.39 | 14 |
| | | 2100 | 0.15 | 0.37 | 1.05 | 0.37 | 16 |
| | | 2200 | 0.24 | 0.64 | 0.96 | 0.42 | 14 |

Table 6. Sediment pesticides ($\mu\text{g/kg}$, dry wt.), Bayou Aux Carpes. January 1985.

| Compound | Sta. 2 | Sta. 3 | Sta. 4 | Sta. 7 | Sta. 8 | Sta. 10a | Sta. 10 | Sta. 11 |
|---------------------------|--------|--------|--------|--------|--------|----------|---------|---------|
| Aldrin | 80U | 60U | 20U | 100U | 20U | 200U | 200U | 10U |
| Heptachlor | 80U | 60U | 20U | 100U | 20U | 200U | 200U | 10U |
| Heptachlor Epoxide | 80U | 60U | 20U | 100U | 20U | 200U | 200U | 10U |
| Alpha-BHC | 80U | 60U | 20U | 100U | 20U | 200U | 200U | 10U |
| Beta-BHC | 80U | 60U | 20U | 100U | 20U | 200U | 200U | 10U |
| Gamma-BHC (Lindane) | 80U | 60U | 20U | 100U | 20U | 200U | 200U | 10U |
| Delta-BHC | 80U | 60U | 20U | 100U | 20U | 200U | 200U | 10U |
| Endosulfan I (Alpha) | 200U | 70U | 30U | 200U | 40U | 40U | 30U | 20U |
| Dieldrin | 200U | 70U | 30U | 200U | 40U | 40U | 30U | 20U |
| 4,4'-DDT (P,P'-DDT) | 700U | 200U | 60U | 300U | 80U | 100U | 70U | 40U |
| 4,4'-DDE (P,P'-DDE) | 700U | 200U | 60U | 300U | 80U | 100U | 70U | 40U |
| 4,4'-DDD (P,P'-DDD) | 700U | 200U | 60U | 300U | 80U | 100U | 70U | 40U |
| Endrin | 700U | 200U | 60U | 300U | 80U | 100U | 70U | 40U |
| Endosulfan II (Beta) | 700U | 200U | 60U | 300U | 80U | 100U | 70U | 40U |
| Endosulfan Sulfate | 1000U | 400U | 100U | 500U | 100U | 100U | 100U | 60U |
| Chlordane (Tech, Mixture) | 800U | 300U | 100U | 800U | 200U | 200U | 200U | 100U |
| PCB-1242 (Aroclor 1242) | 800U | 500U | 200U | 1000U | 300U | 1000U | 2000U | 100U |
| PCB-1254 (Aroclor 1254) | 6000U | 2000U | 600U | 3000U | 800U | 1000U | 700U | 500U |
| PCB-1221 (Aroclor 1221) | 800U | 600U | 200U | 1000U | 300U | 1000U | 2000U | 100U |
| PCB-1232 (Aroclor 1232) | 800U | 600U | 200U | 1000U | 300U | 1000U | 2000U | 100U |
| PCB-1248 (Aroclor 1248) | 800U | 600U | 200U | 1000U | 300U | 1000U | 2000U | 100U |
| PCB-1260 (Aroclor 1016) | 6000U | 2000U | 600U | 3000U | 800U | 1000U | 700U | 500U |
| PCB-1016 (Aroclor 1016) | 800U | 500U | 200U | 1000U | 300U | 1000U | 2000U | 100U |
| Toxaphene | 10000U | 4000U | 1000U | 9000U | 2000U | 2000U | 2000U | 900U |
| Endrin Aldehyde | 1000U | 400U | 100U | 500U | 100U | 100U | 100U | 60U |
| Methoxychlor | 700U | 400U | 100U | 1000U | 200U | 100U | 200U | 80U |
| Moisutre % | 90 | 90 | 75 | 70 | 88 | 76 | 78 | 67 |

U - Material was analyzed for but not detected. The reported concentration is the minimum detection limit.

Table 7. Benthic Macroinvertebrates, Qualitative Collections, 000073
Bayou aux Carpes, Louisiana, January 1985.

| Organism | Forested Sta. 2 | Swamp Sta. 7 | Marsh Sta. 8 | Marsh Sta. 10 | Canal Sta. 4 |
|--|--------------------|-----------------|-----------------|------------------|-----------------|
| DIPTERA | | | | | |
| <u>Glyptotendipes</u> sp. | | | | | X |
| <u>Ablabesmyia</u> <u>peleensis</u> | | X | | | |
| <u>Polypedilum</u> prob. <u>illinoense</u> | | X | | | |
| <u>Goeldichironomus</u> <u>holoprasinus</u> | | | X | | |
| <u>Chironomus</u> <u>plumosus</u> group | | | X | | |
| <u>Tanypus</u> <u>neopunctipennis</u> | | | | X | |
| EPHEMEROPTERA | | | | | |
| <u>Siphonuridae</u> (damaged) | | | | | X |
| ODONATA | | | | | |
| <u>Miathyria</u> <u>marcella</u> | X | | | | |
| <u>Pachydiplax</u> <u>longipennis</u> | X | | | | |
| <u>Coryphaeschna</u> <u>ingens</u> | X | | | | |
| <u>Anomalagrion</u> sp. | X | | | | |
| <u>Nasiaeschna</u> sp. | | | | | X |
| <u>Boyeria</u> <u>vinosa</u> | | X | | | |
| <u>Anax</u> <u>amazili</u> | | | X | | |
| <u>Enallagma</u> sp. | | X | X | | X |
| <u>Ischnura</u> sp. | | X | X | | X |
| HEMIPTERA | | | | | |
| <u>Ranatra</u> sp. | | | | | X |
| CRUSTACEA | | | | | |
| <u>Hyaella</u> <u>azteca</u> | X | X | X | X | X |
| <u>Gammarus</u> sp. | | | | | X |
| <u>Asellus</u> sp. | X | X | X | X | X |
| <u>Lirceus</u> sp. | | | X | X | |
| <u>Astacidae</u> | X | X | | | |
| <u>Astacidae</u> , prob. <u>Cambarellinae</u> | | X | | | |
| <u>Palaemonetes</u> <u>kadiakensis</u> | | | | X | X |
| <u>Callinectes</u> <u>sapidus</u> | | | | X | X |
| <u>Uca</u> sp. | | | | | X |
| BIVALVIA | | | | | |
| <u>Musculium</u> sp. | | X | | | X |
| GASTROPODA | | | | | |
| <u>Physella</u> prob. <u>heterostropha</u> <u>pomila</u> | X | X | X | X | X |
| <u>Stagnicola</u> sp. | | X | | | |
| <u>Menetus</u> sp. | | X | | | |
| <u>Fossaria</u> sp. | | | | X | |
| <u>Laevapex</u> sp. | X | X | | X | |
| TOTAL TAXA | 9 | 14 | 9 | 9 | 14 |

Table 8. Fish Collected, Bayou Aux Carpes, Louisiana, January 1985.

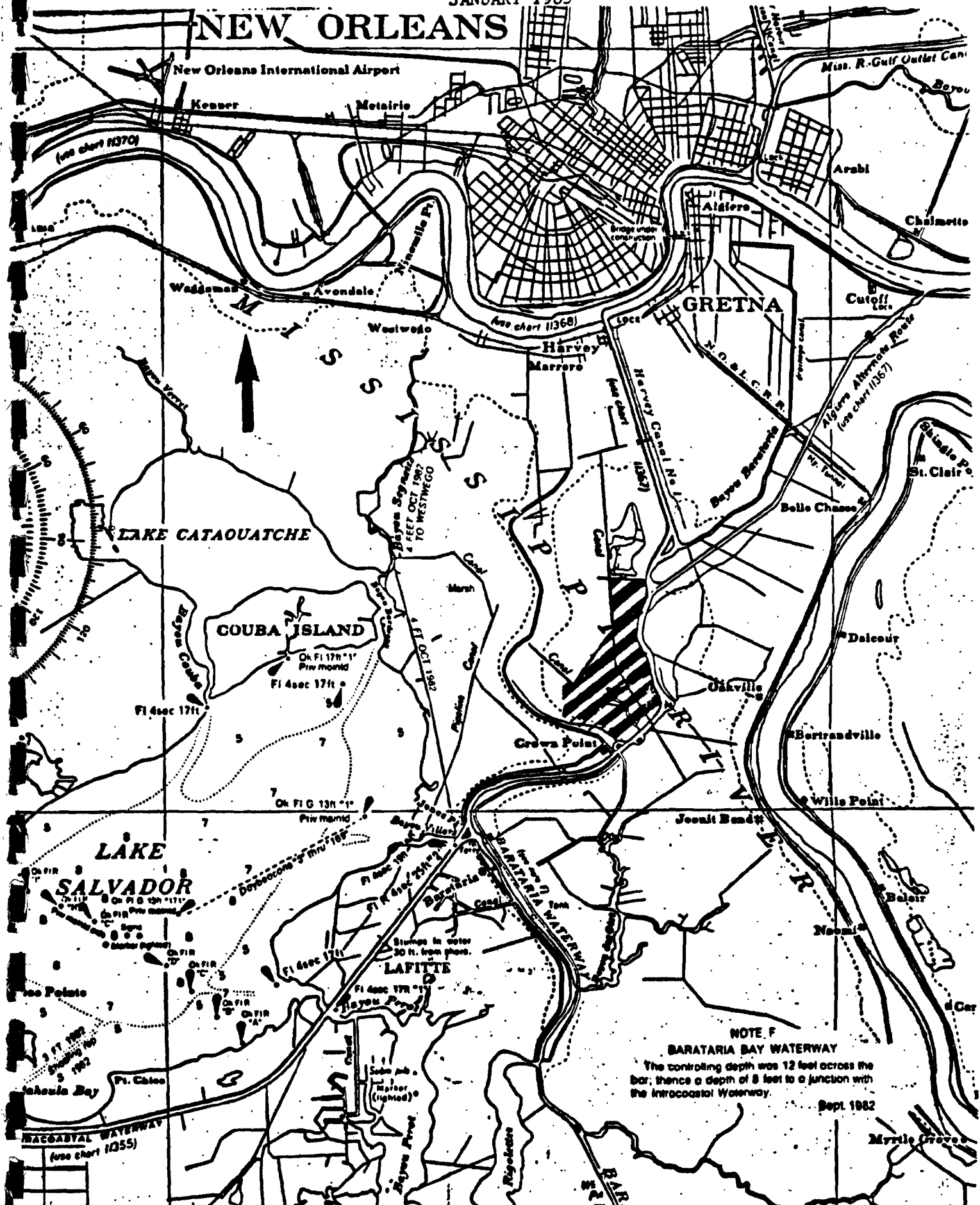
| Organism | Forested Sta. 2 | Swamp Sta. 7 | Marsh Sta. 10 | Canal Sta. 4 |
|----------------------------|--------------------|-----------------|------------------|-----------------|
| Clupeidae | | | | |
| <u>Dorosoma cepedianum</u> | | X | | |
| Engraulidae | | | | |
| <u>Anchoa mitchilli</u> * | | X | | |
| Cyprinodontidae | | | | |
| <u>Fundulus cingulatus</u> | | | X | |
| Poeciliidae | | | | |
| <u>Gambusia affinis</u> | X | | X | X |
| <u>Heterandria formosa</u> | X | X | X | X |
| <u>Poecilia latipinna</u> | | | X | |
| Centrarchidae | | | | |
| <u>Elassoma zonatum</u> | X | | X | X |
| <u>Lepomis punctatus</u> | | | | X |
| <u>L. sp.</u> | | X | | |
| TOTAL TAXA | 3 | 4 | 5 | 4 |

*Estuarine species

FIGURE 1
SITE LOCATION
BAYOU AUX CARPES
JANUARY 1985

030075 000075

NEW ORLEANS



NOTE F
BARATARIA BAY WATERWAY
The controlling depth was 12 feet across the bar; thence a depth of 8 feet to a junction with the Intracoastal Waterway.
Sept. 1982

FIGURE 2
BAYOU AUX CARPES
JEFFERSON PARISH, LOUISIANA

000076

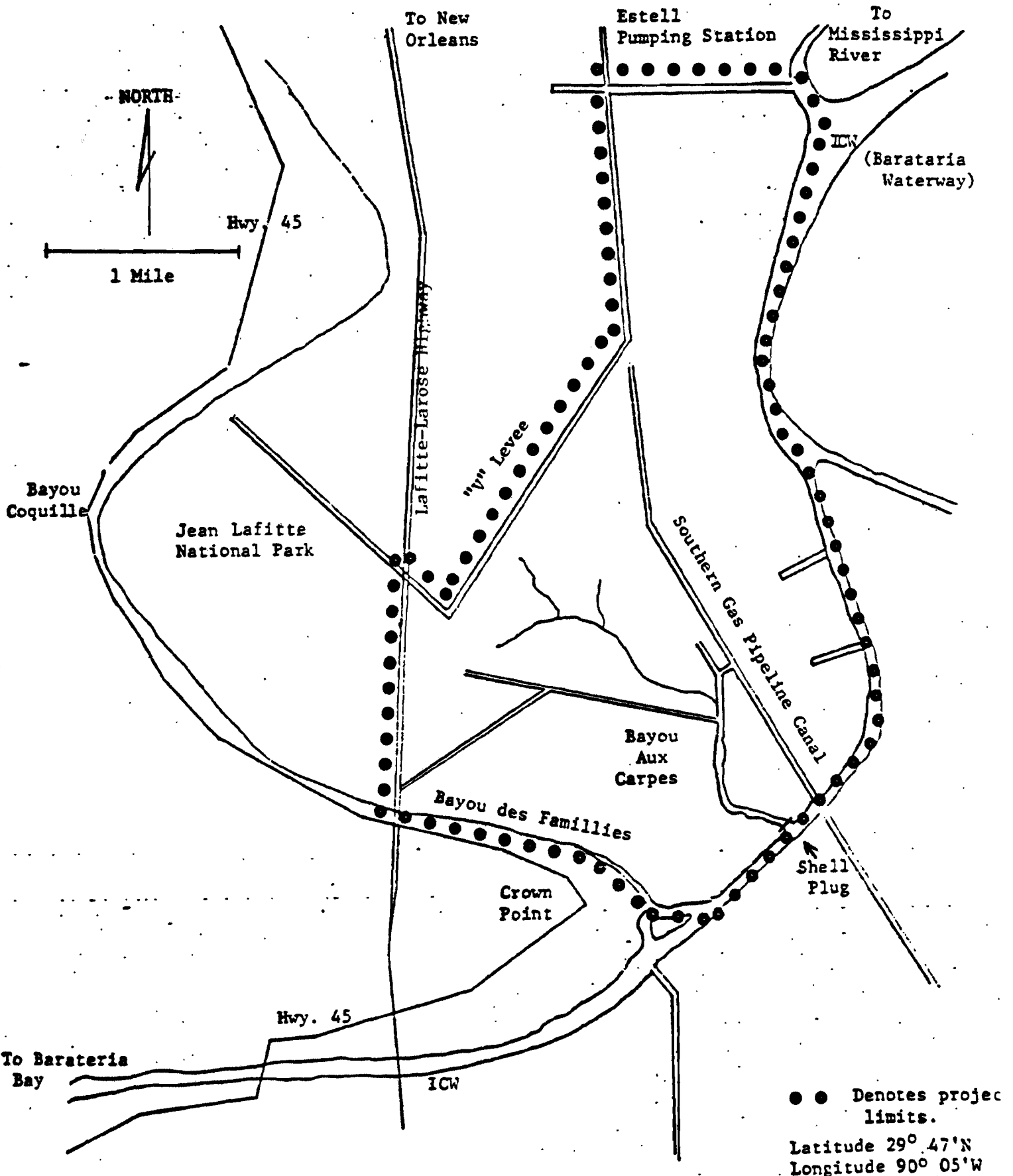


FIGURE 3
HYDROGRAPHIC MONITORING LOCATIONS
BAYOU AUX CARPES
JANUARY 1985

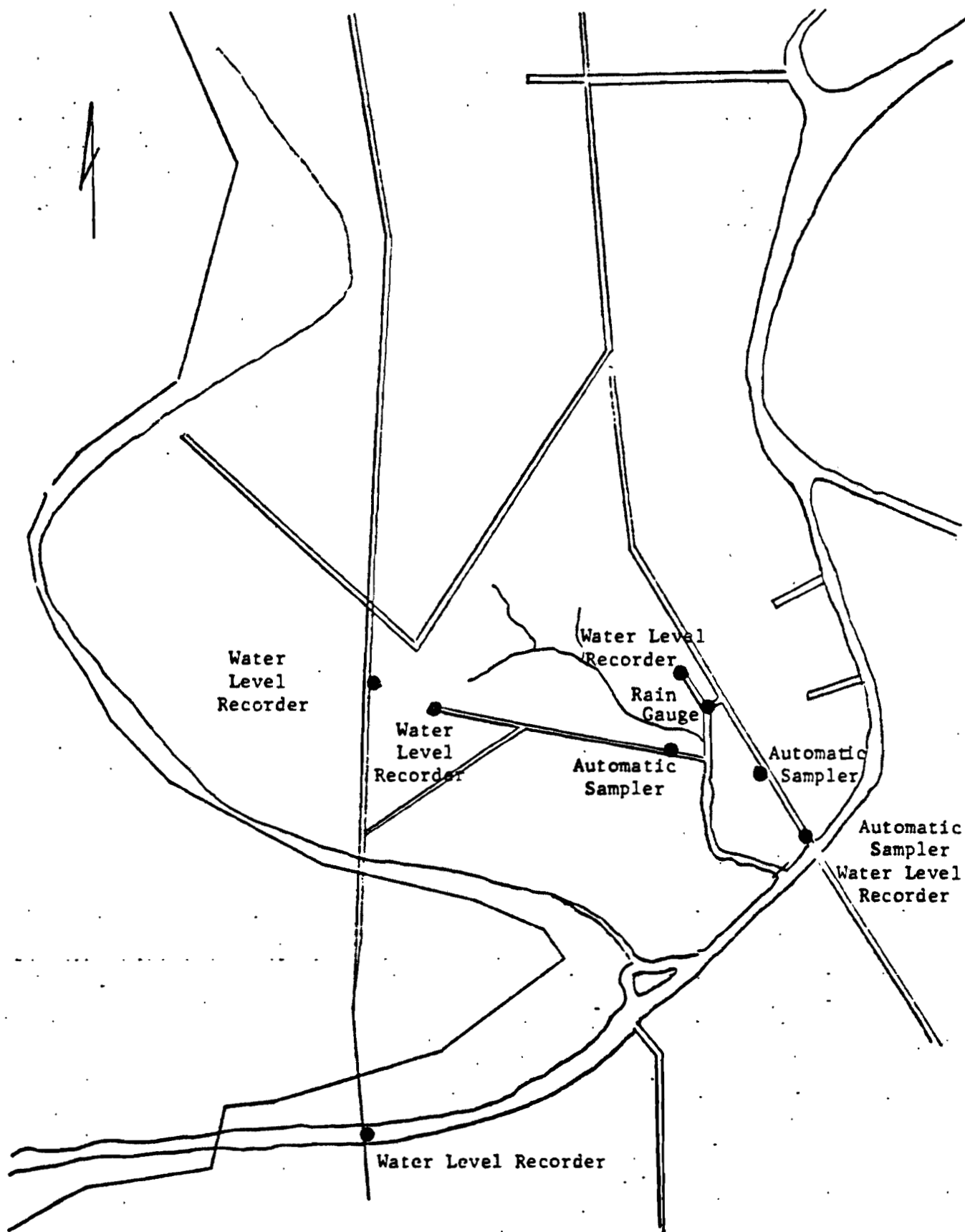


FIGURE 4.
Stations for water quality sampling,
Bayou Aux Carpes Study
January, 1985

000078

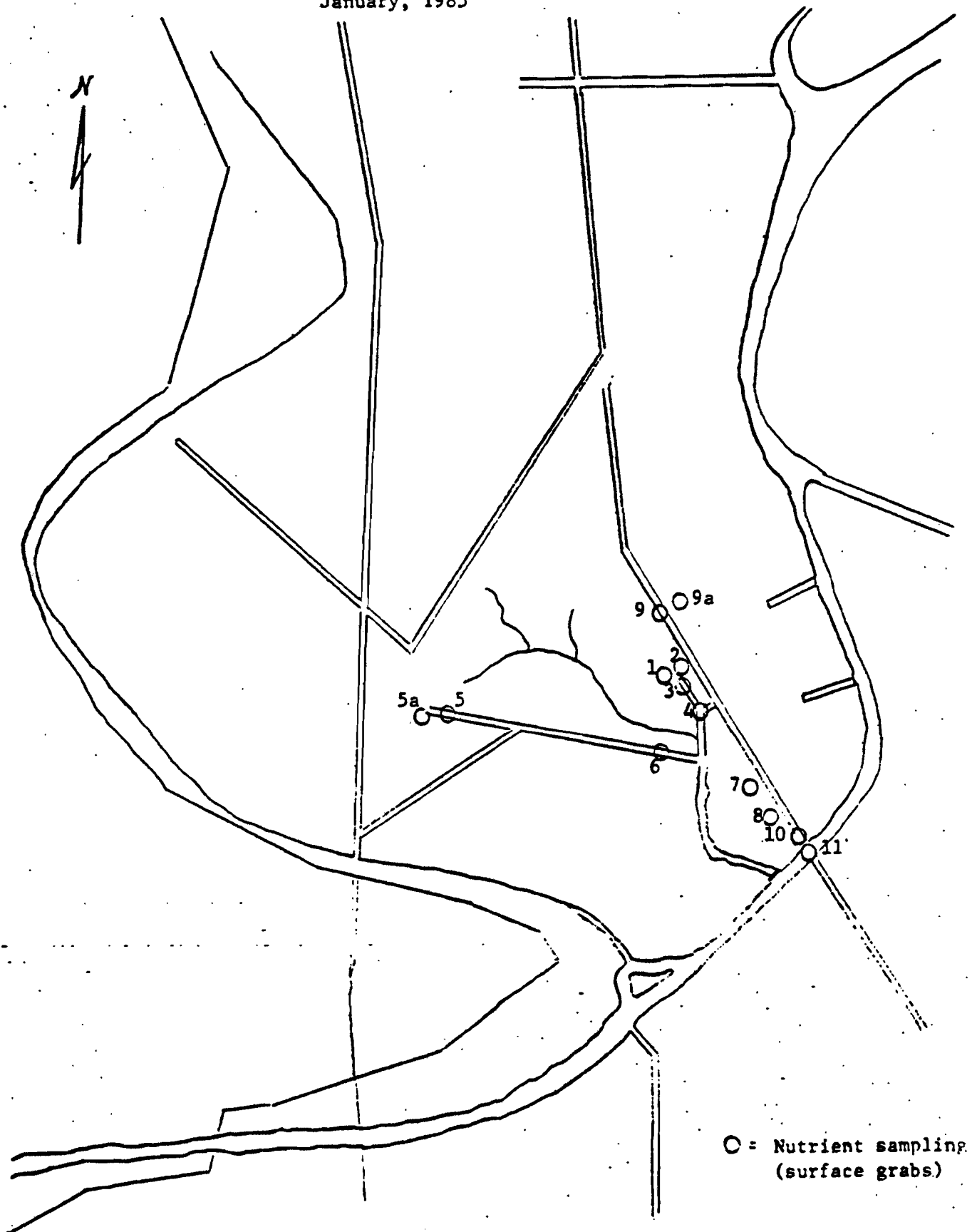
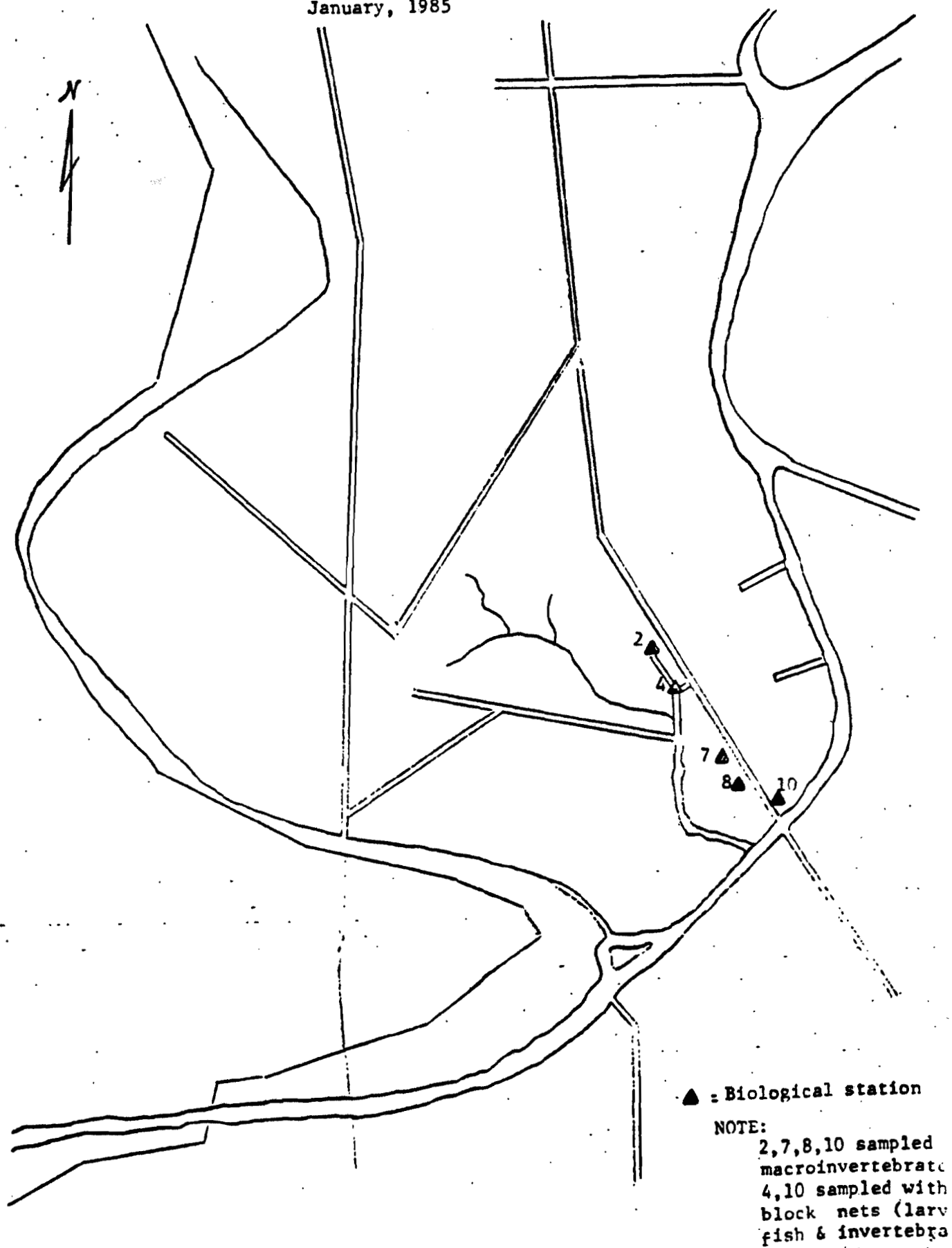


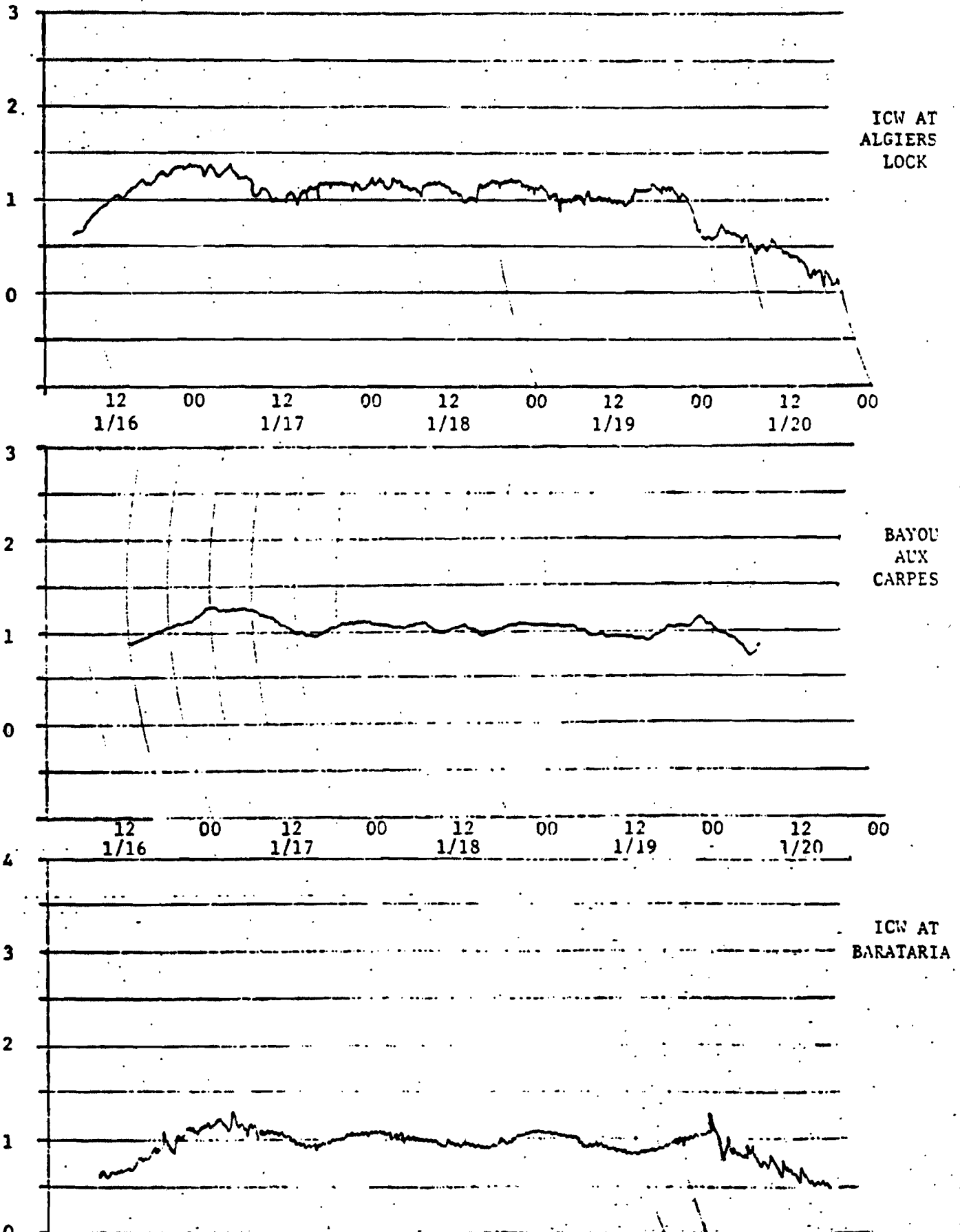
FIGURE 5.
Station for biological sampling,
Bayou Aux Carpes Study
January, 1985



000080

000030

FIGURE 6
WATER LEVELS
BAYOU AUX CARPES
JANUARY 16-20, 1985

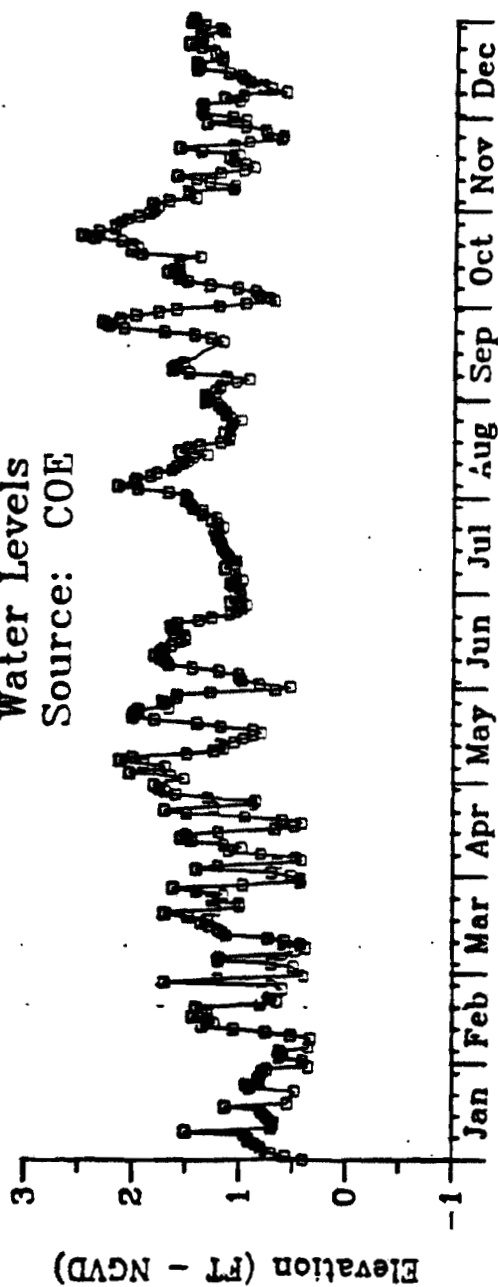


DAILY WATER LEVEL RECORDINGS AT 0600 HOURS. COL. AT ALGIERS AND BARATARIA, ALGERIA
1984 BAYOU AUX CARPES, LOUISIANA

000081

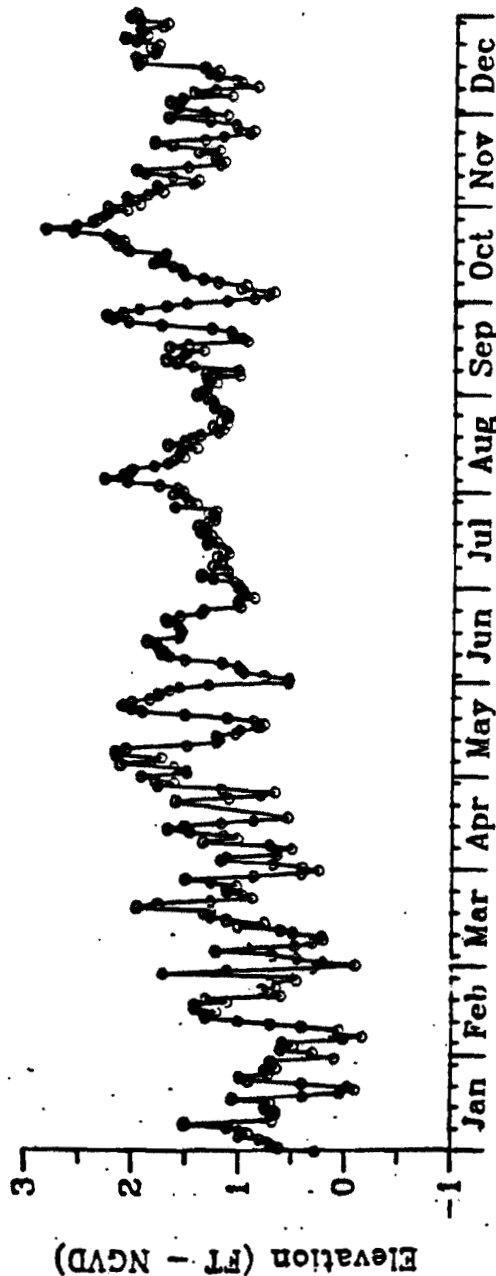
000031

Water Levels
Source: COE



Jan 84 - Dec 84

ALGIERS
Mean 1.28
Range -0.17
S. D. 0.53



Jan 84 - Dec 84

000082

000030

FIGURE 8
WIND SPEED AND DIRECTION
MOISANT INTERNATIONAL AIRPORT
NEW ORLEANS, LA
JANUARY 1985

- Wind -
Direction Speed (Knots)

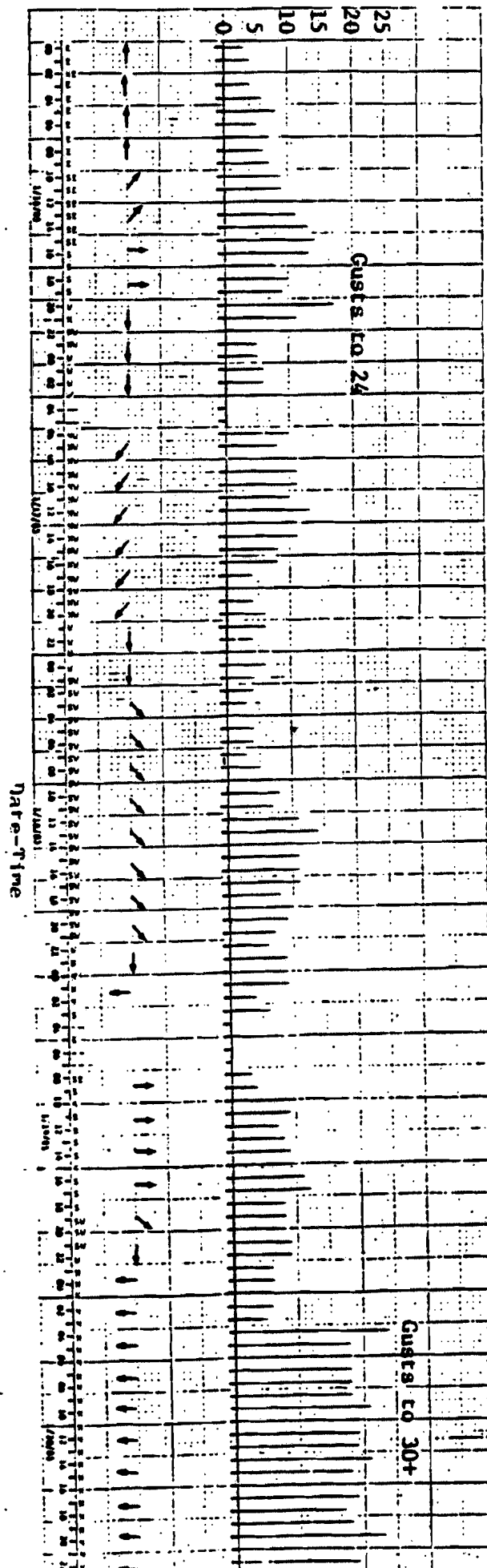
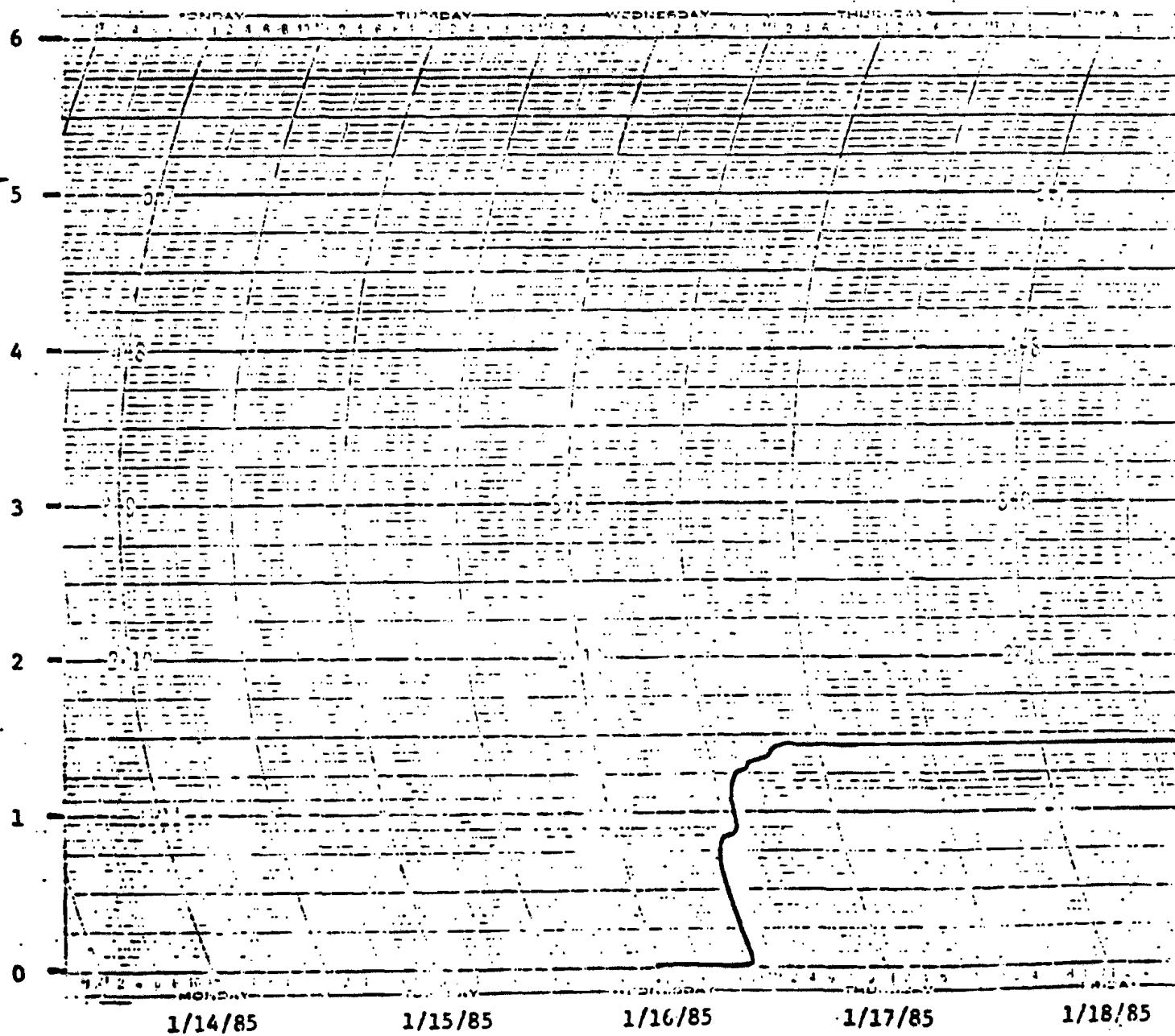


FIGURE 9
RAINFALL
BAYOU AUX CARPES
JANUARY 1985

000035

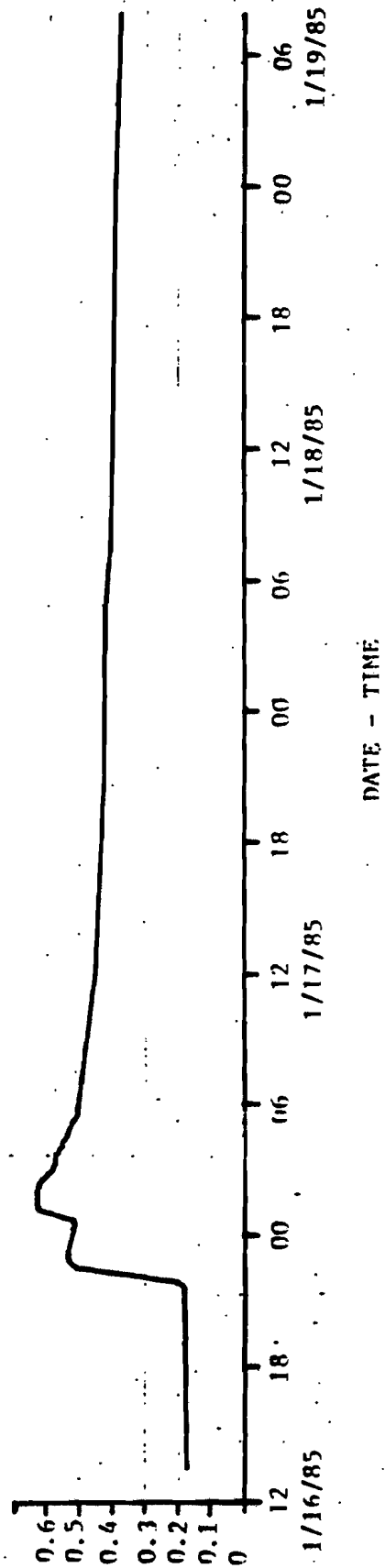


DATE - TIME

000084

000034

FIGURE 10
WATER LEVEL
EAST BORROW DITCH
LAFITTE/LAROSE HWY.
BAYOU AUX CARPES
JANUARY 1985



WATER LEVEL (STAFF GAUGE - FT.)

FIGURE 11
WATER LEVEL COMPARISON ON 1/16/85
BAYOU AUX CARPES
JANUARY, 1985

000035

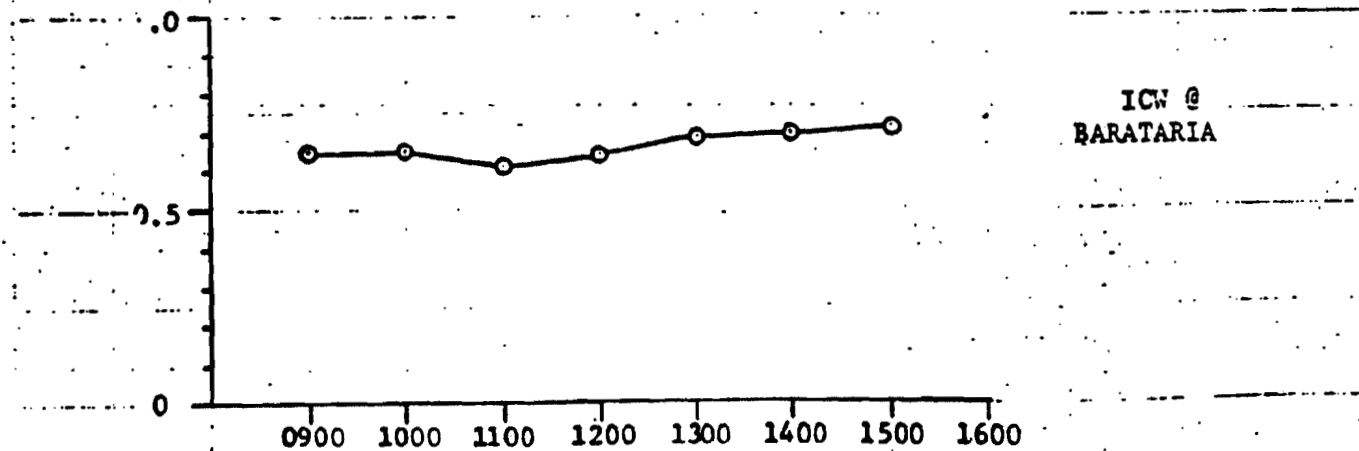
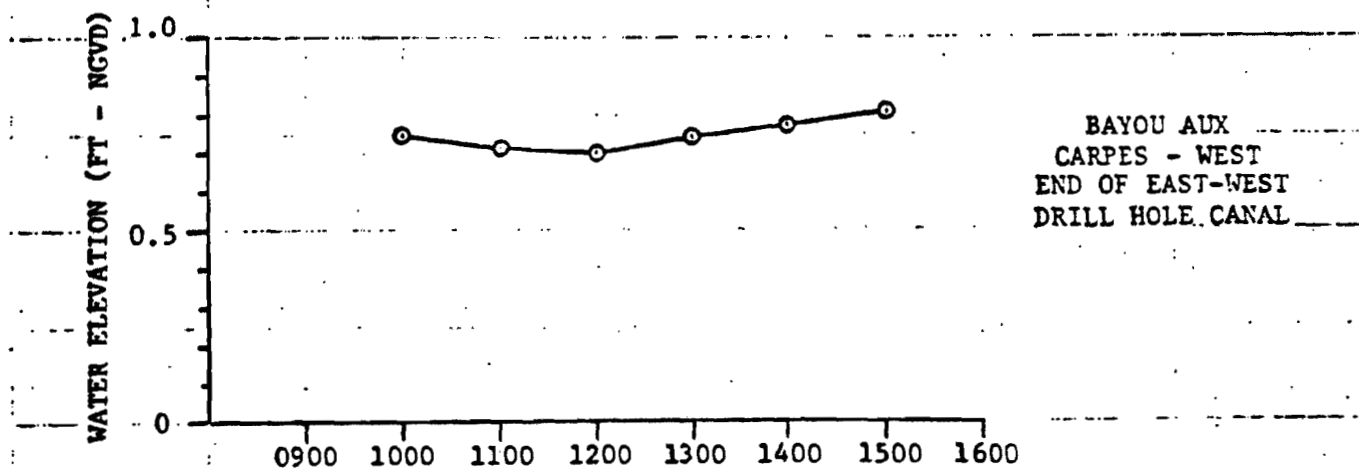
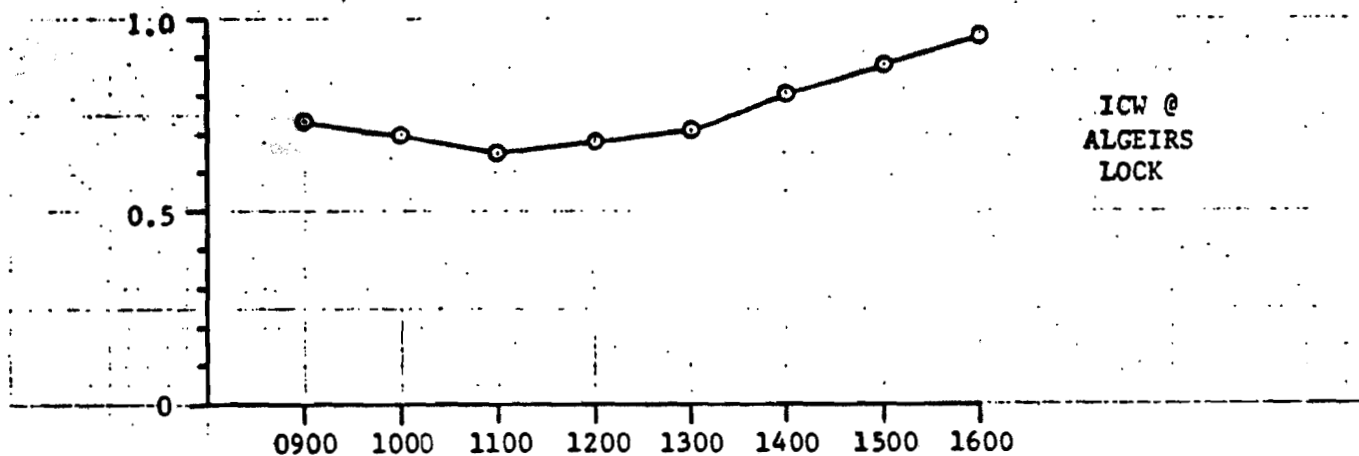


FIGURE 12
GROUND SURFACE TRANSECTS
BAYOU AUX CARPES
JANUARY 1985

000086

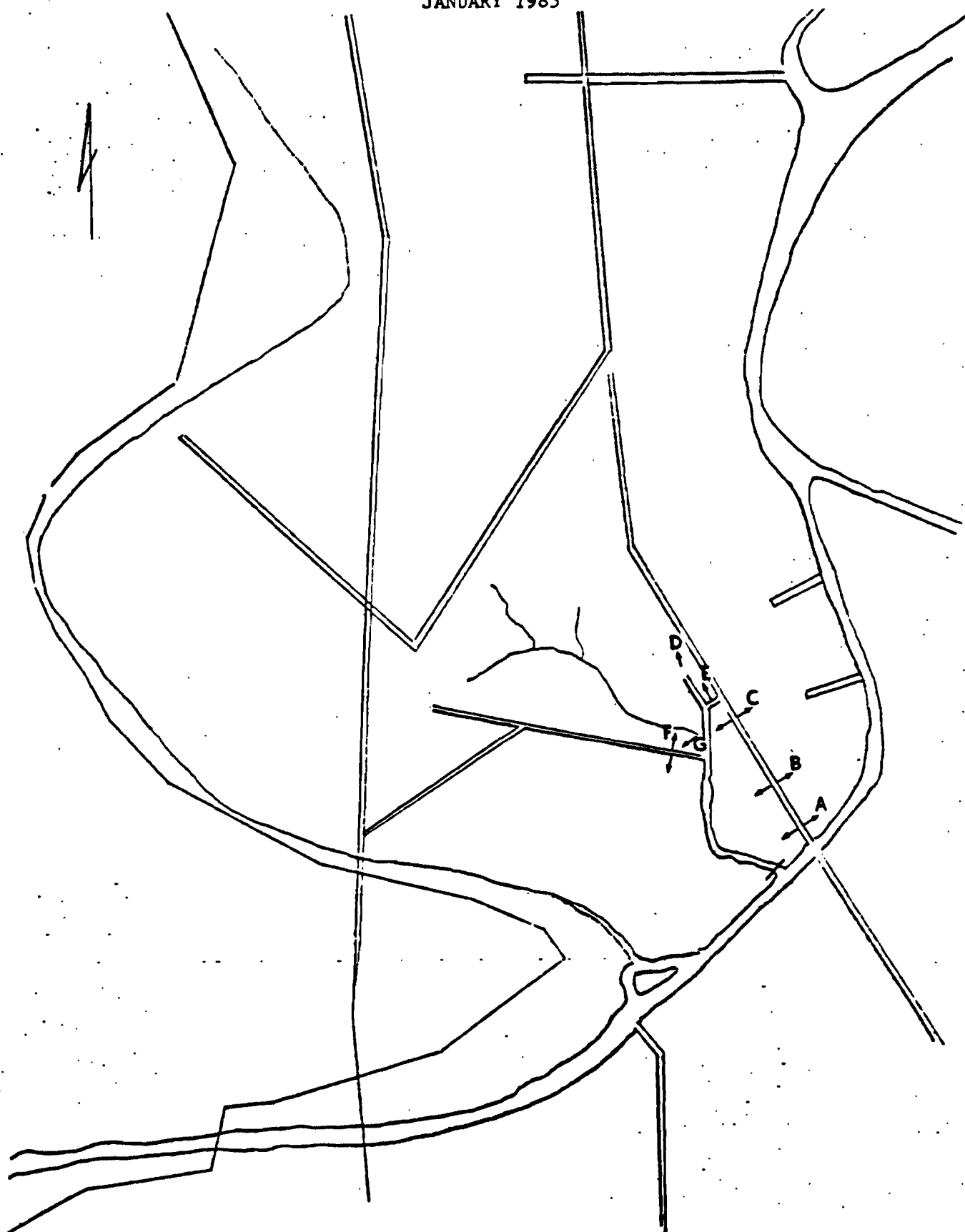


FIGURE 13

FREQUENCY OF DAILY WATER LEVELS FOR 1984 AT THE COE ALGIERS AND BARATARIA STAGING STATIONS.
BAYOU AUX CARPES, LOUISIANA

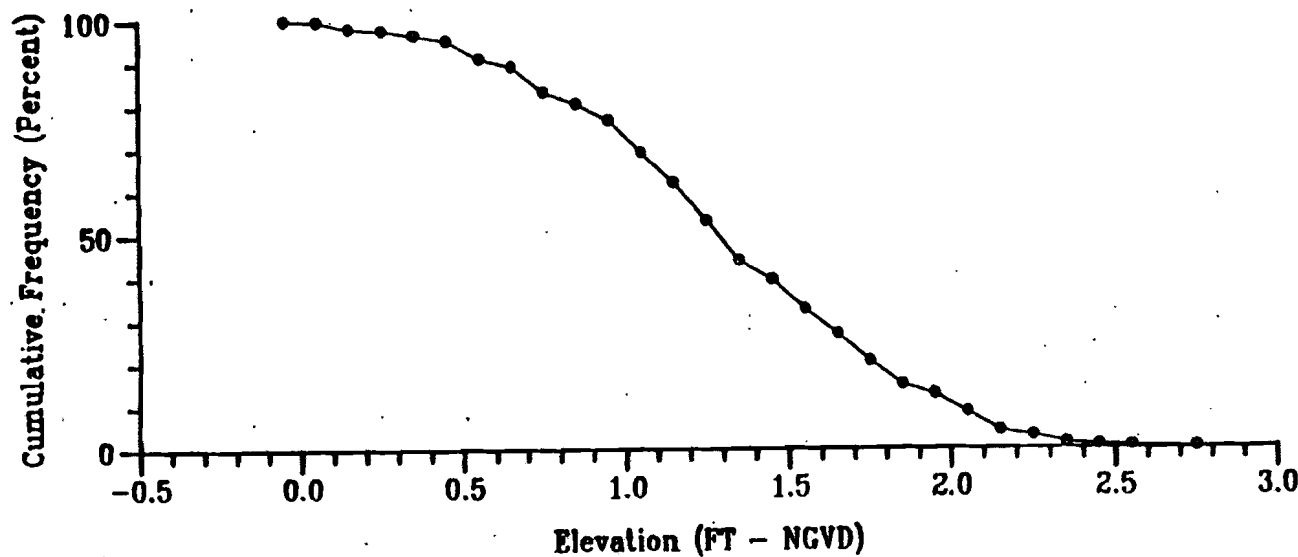
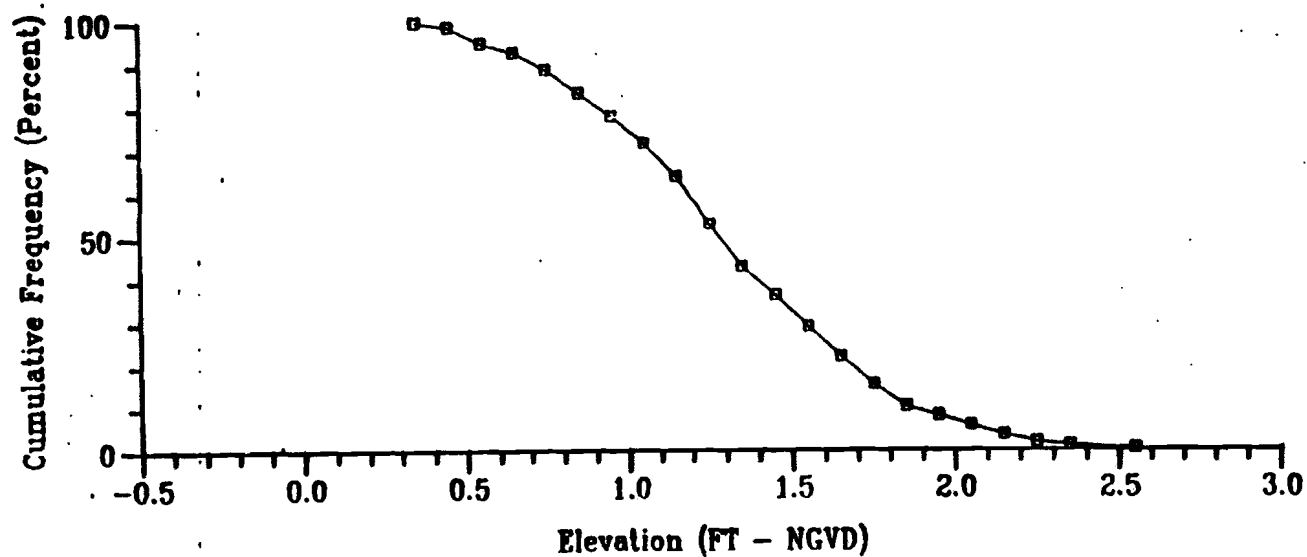
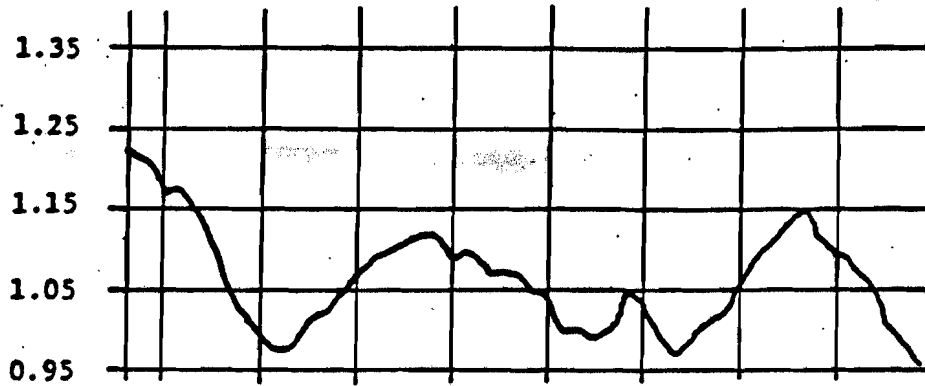


FIGURE 14
WATER LEVELS, CHLORIDES AND DYE TRACER
SNGP CANAL AT JCT. WITH ICW
BAYOU AUX CARPES

000088

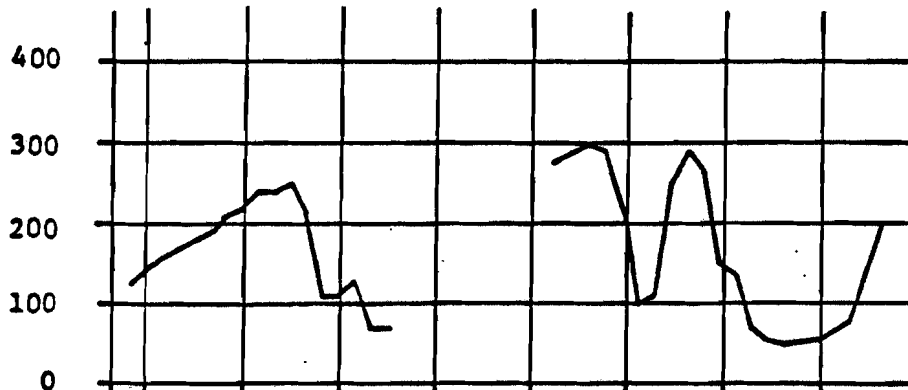
WATER
LEVEL

(Feet)



CHLORIDE
CONCENTRATION

(mg/L)



TRACER
CONCENTRATION

(ppb)

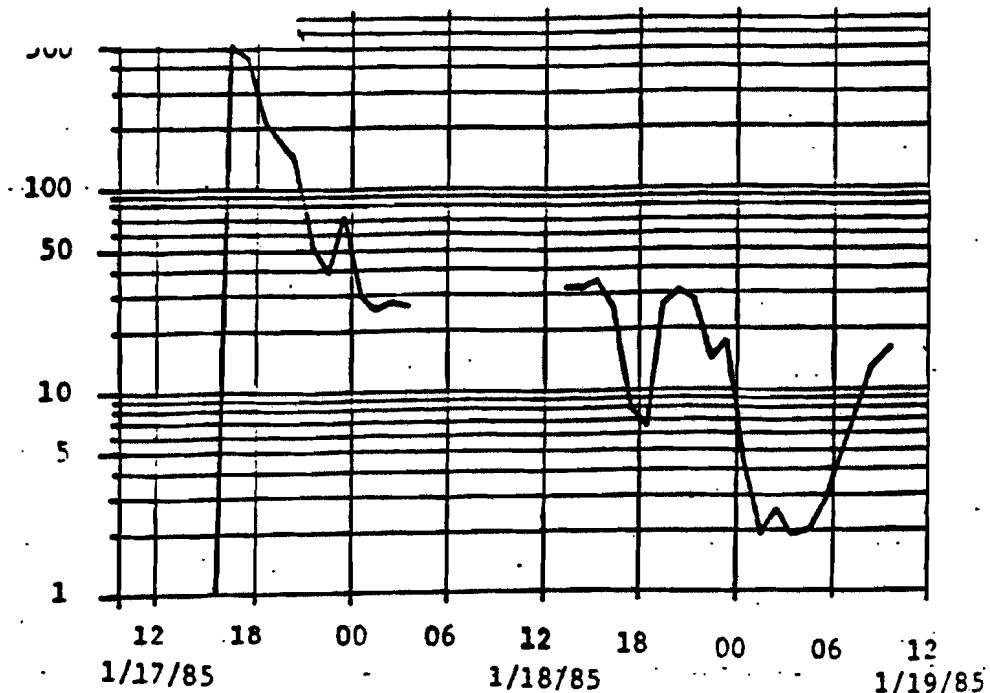


FIGURE 15
DYE TRACER STUDY
BAYOU AUX CARPES
JANUARY, 1985

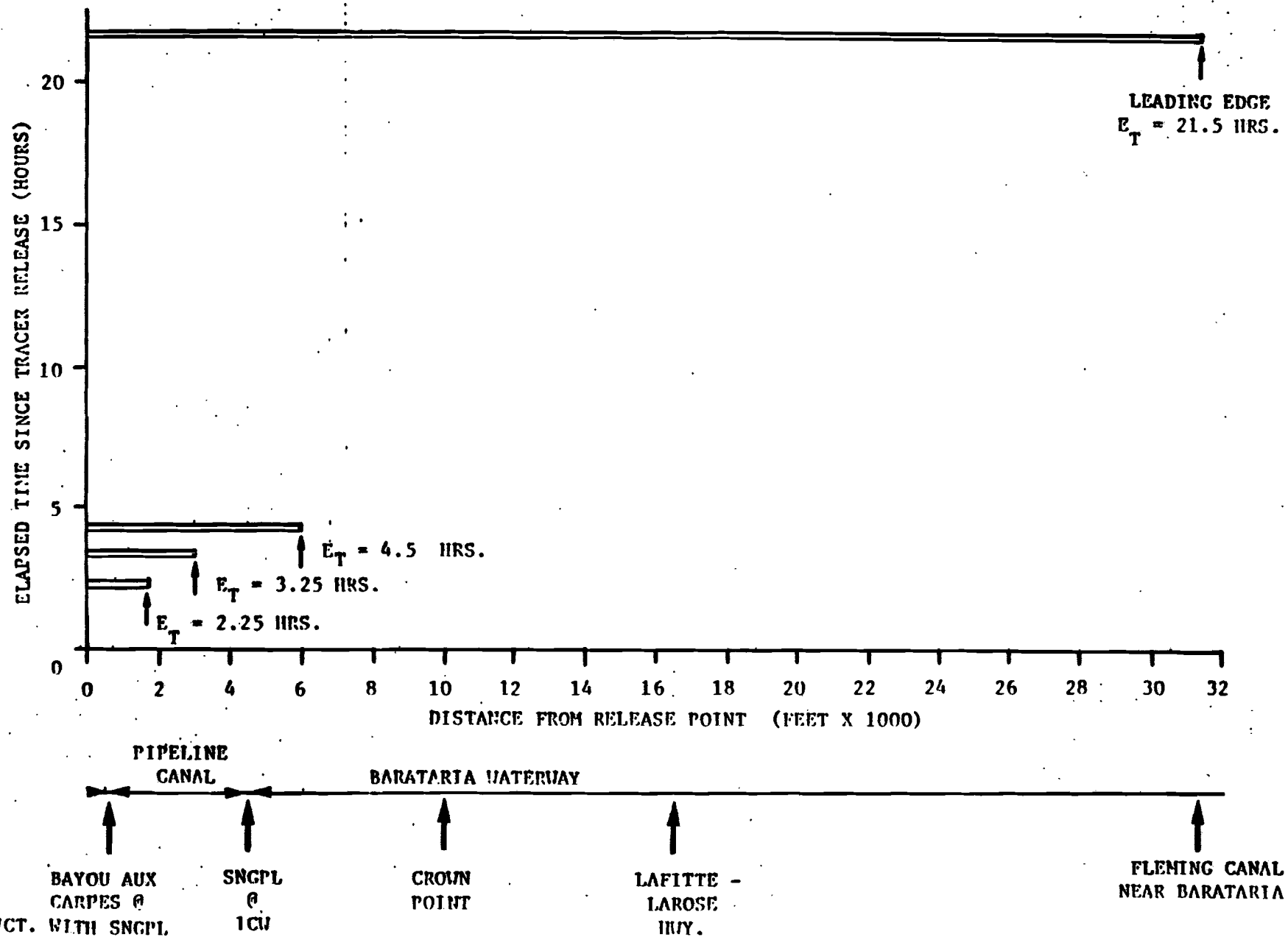


FIGURE 16
WATER LEVELS, TOTAL ORGANIC CARBON AND TOTAL ORGANIC NITROGEN
SNGP CANAL AT JCT. WITH ICW
DAYOU AUX CARPES

000000

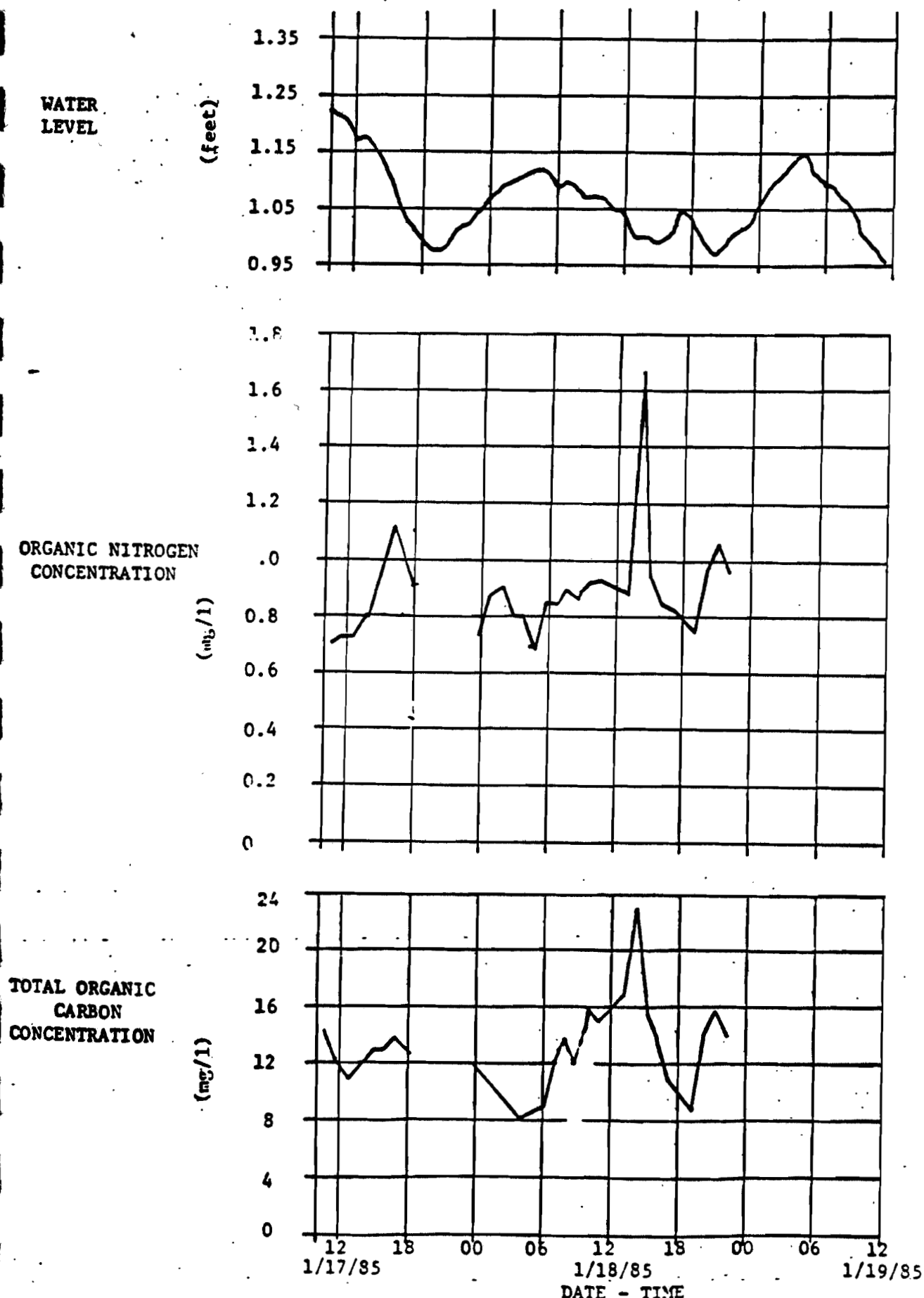
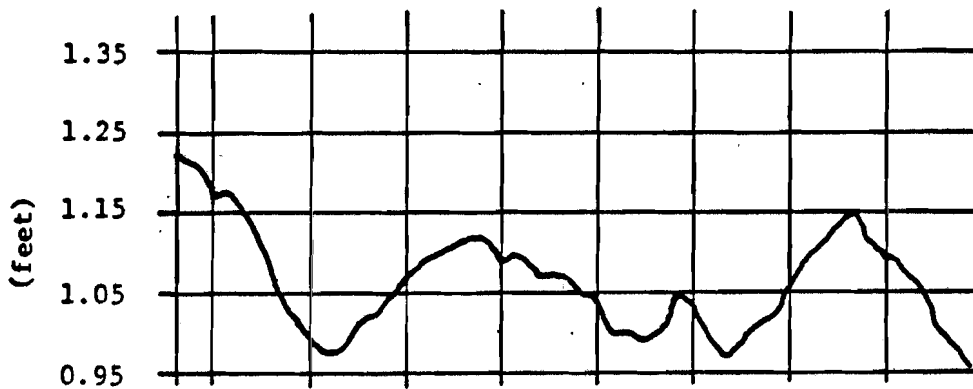


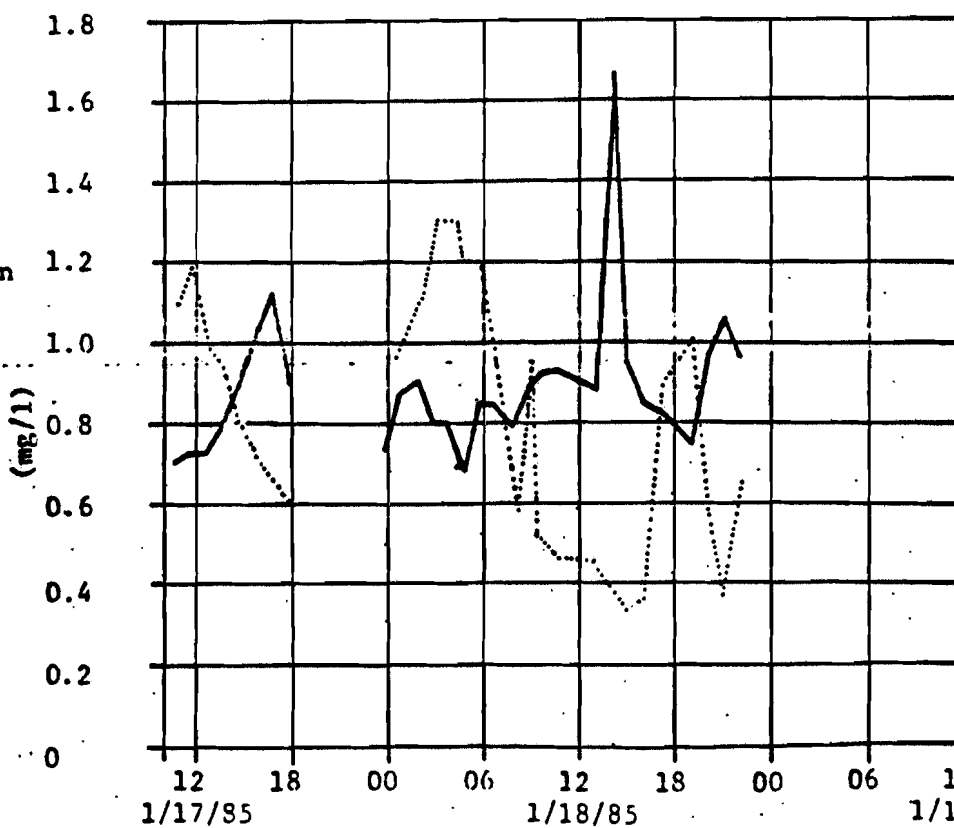
FIGURE 17
WATER LEVELS AND NITROGEN FORMS
SNGP CANAL AT JCT. WITH ICW
BAYOU AUX CARPES

000091

Water
Level



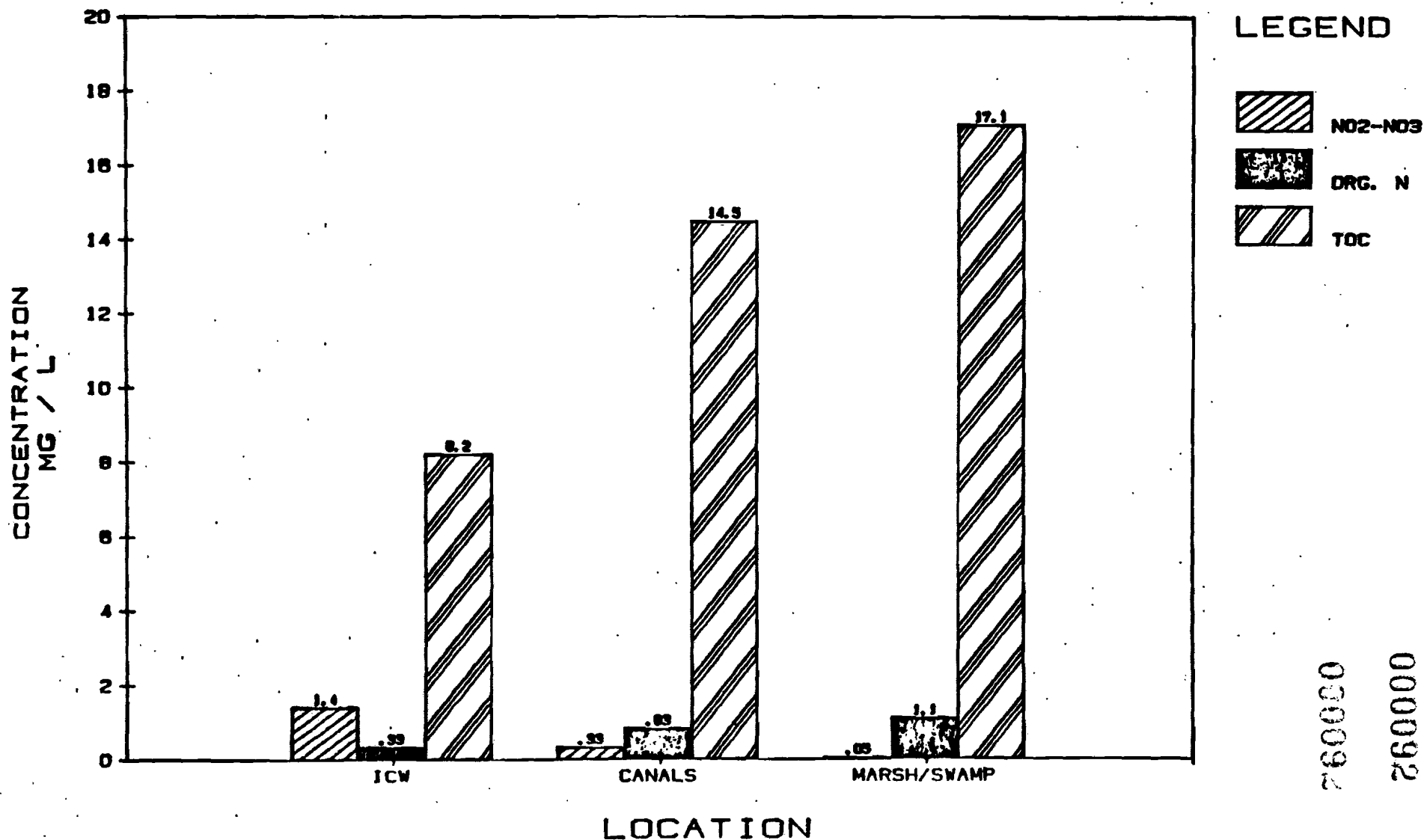
Nitrogen
Concentration



KEY

..... NO₂-NO₃
—— Organic N

FIGURE 18
 NO2-NO3. ORG. N. TOC COMPARISON
 BAYOU AUX CARPES
 JANUARY, 1985



000092
 000092

FIGURE 19.

SEDIMENT SIZE COMPOSITION, CANALS AND ICW,
BAYOU AUX CARPES.

000093

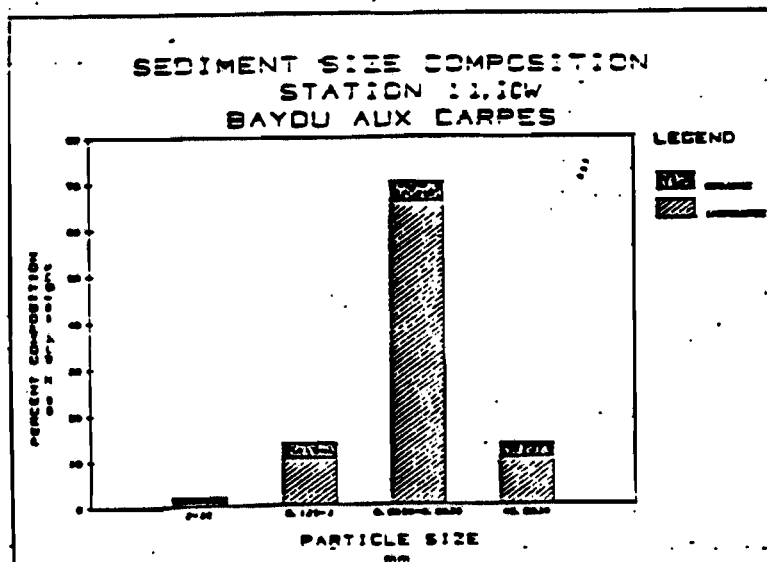
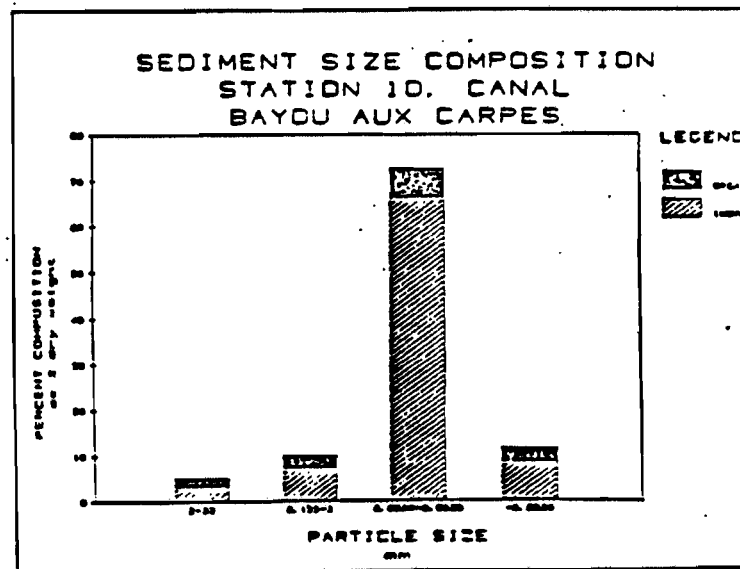
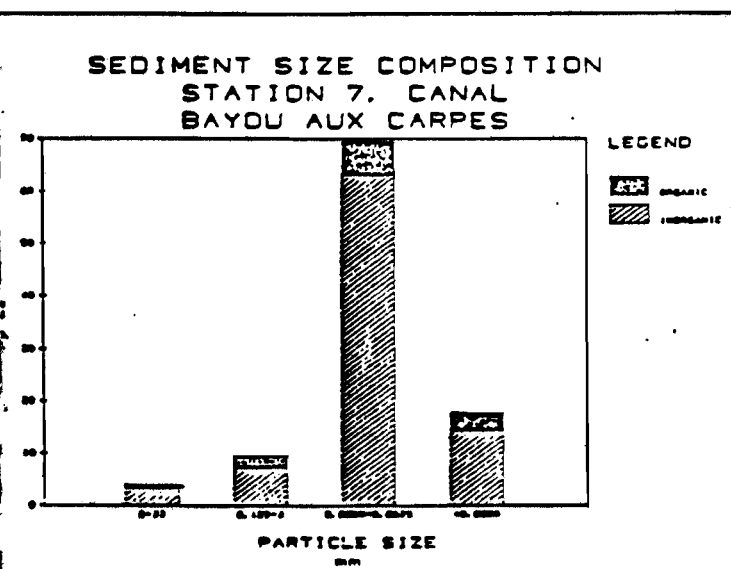
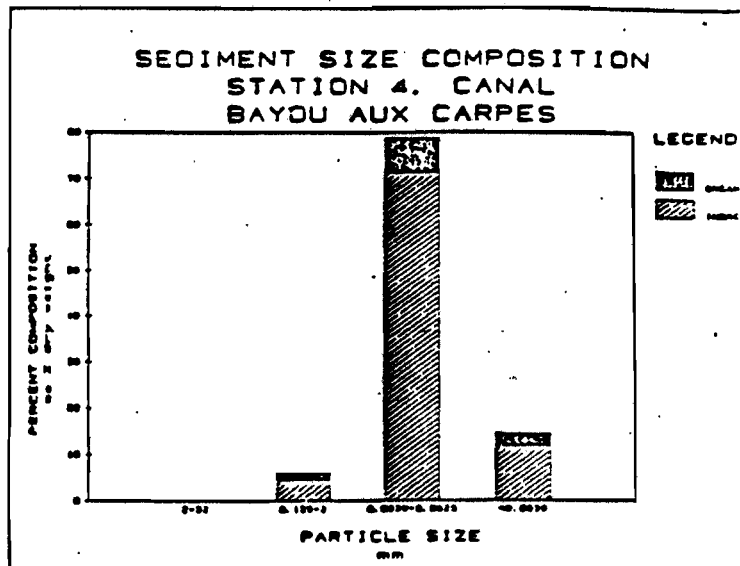
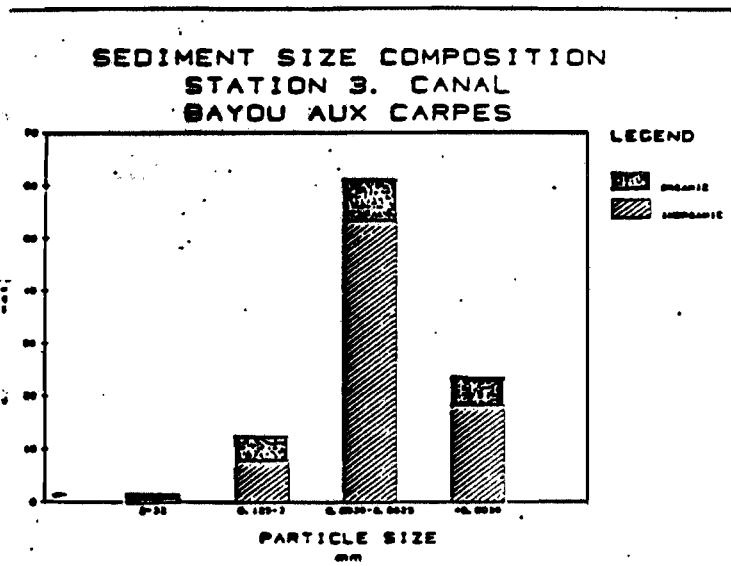
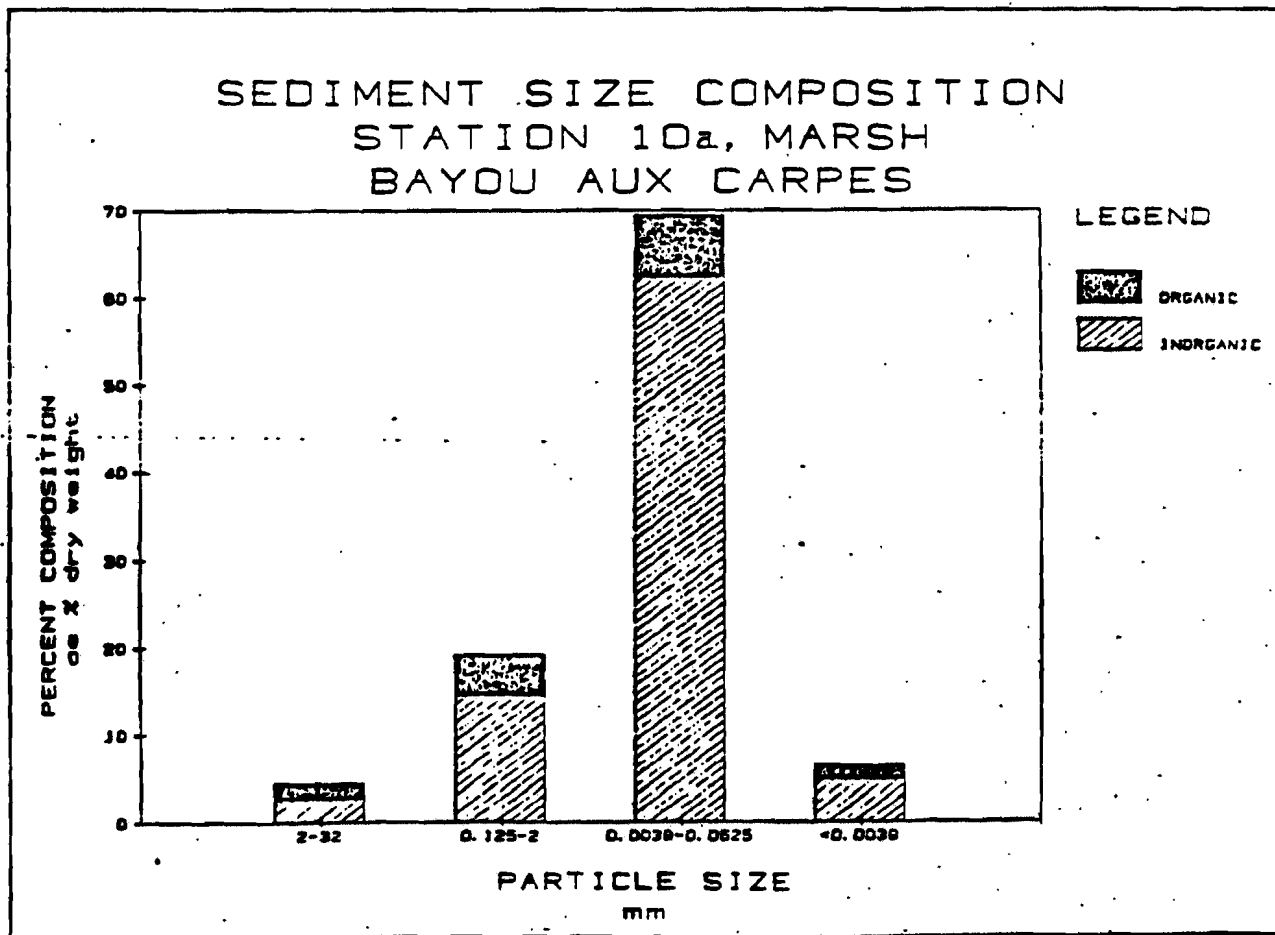
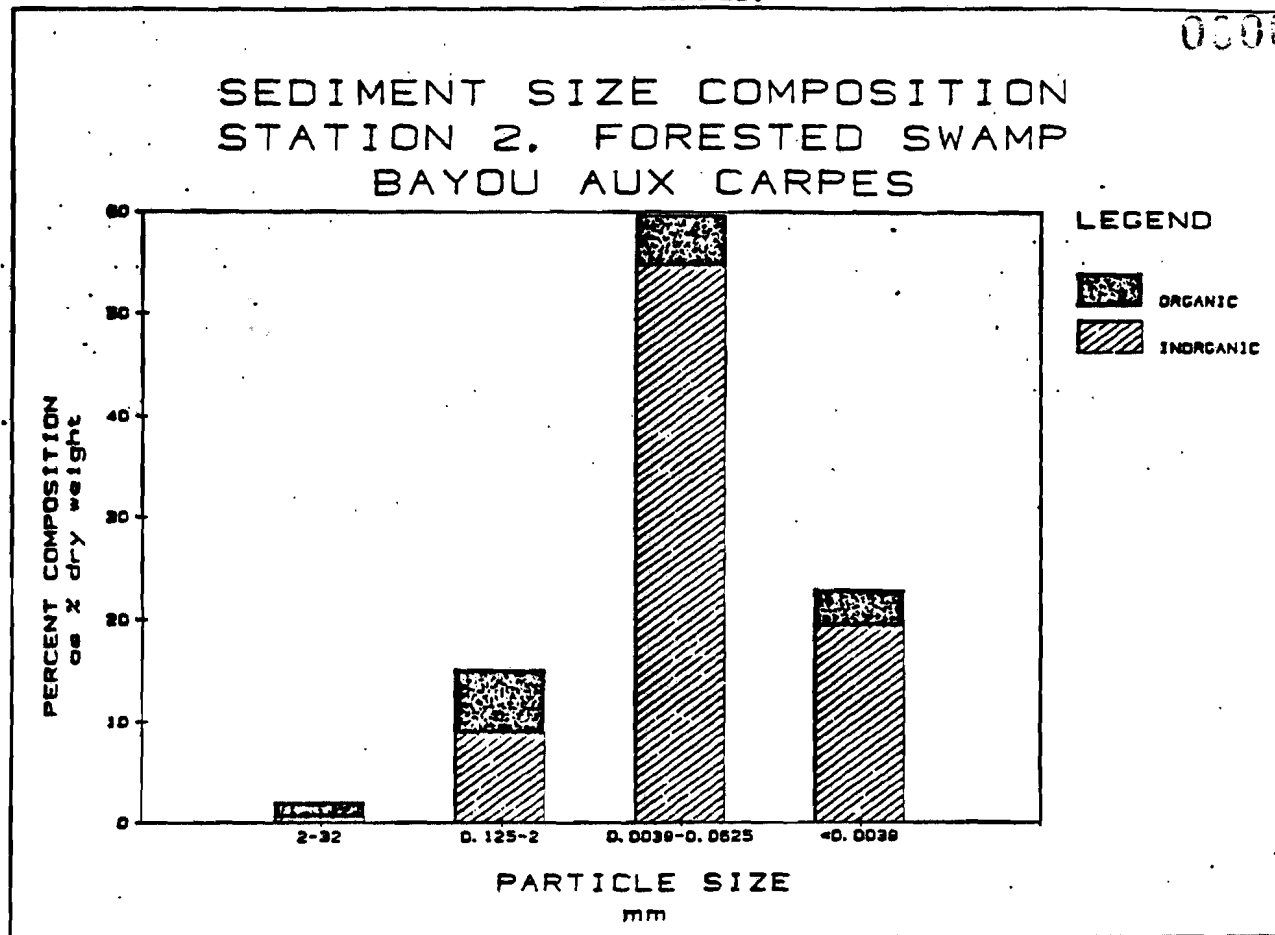


FIGURE 20.

SEDIMENT SIZE COMPOSITION, FORESTED SWAMP AND MARSH,
BAYOU AUX CARPES.

000094

000094



SEDIMENT SIZE COMPOSITION, FORESTED SWAMP AND MARSH,
BAYOU AUX CARPES.

000095

000096

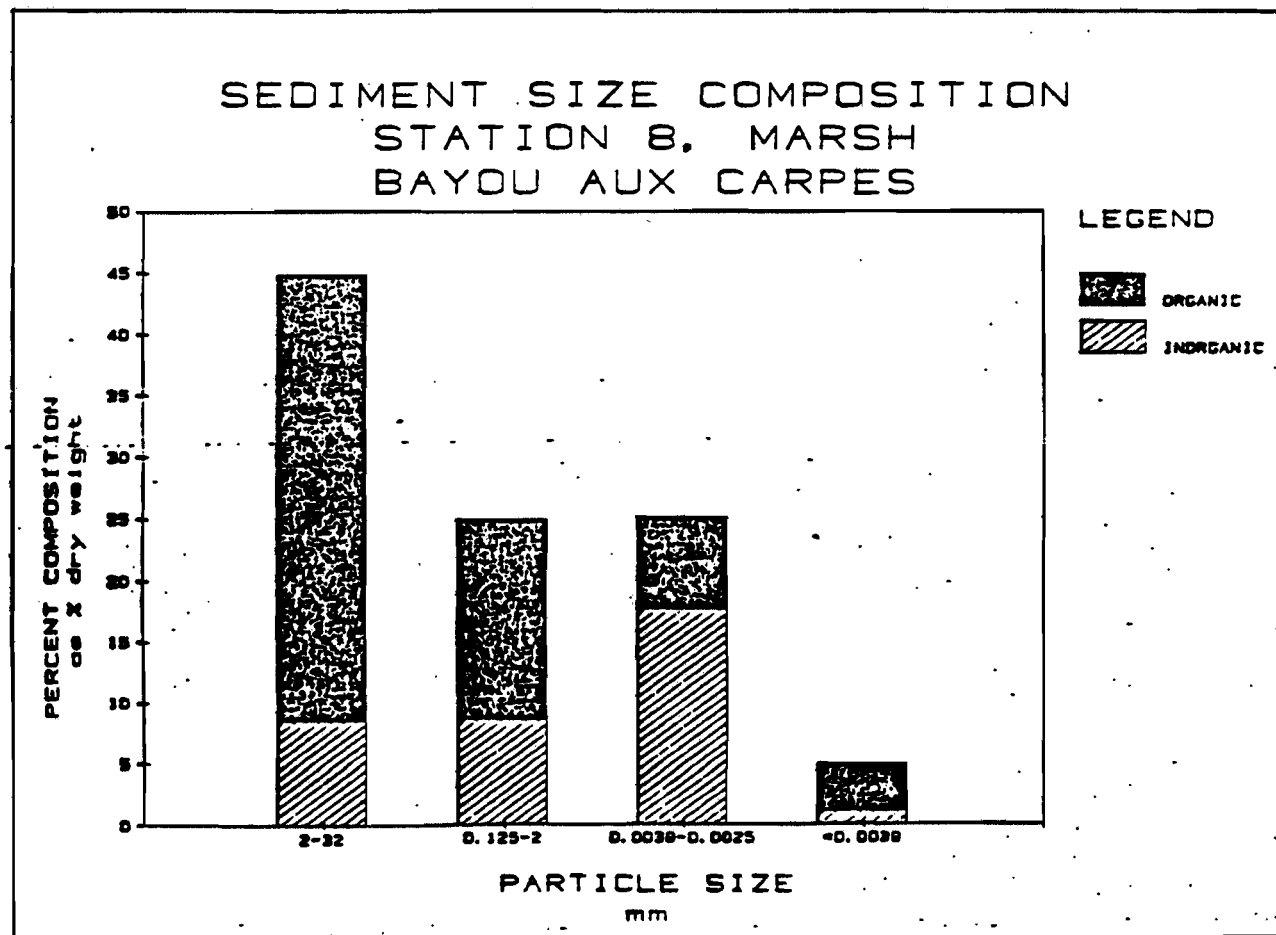
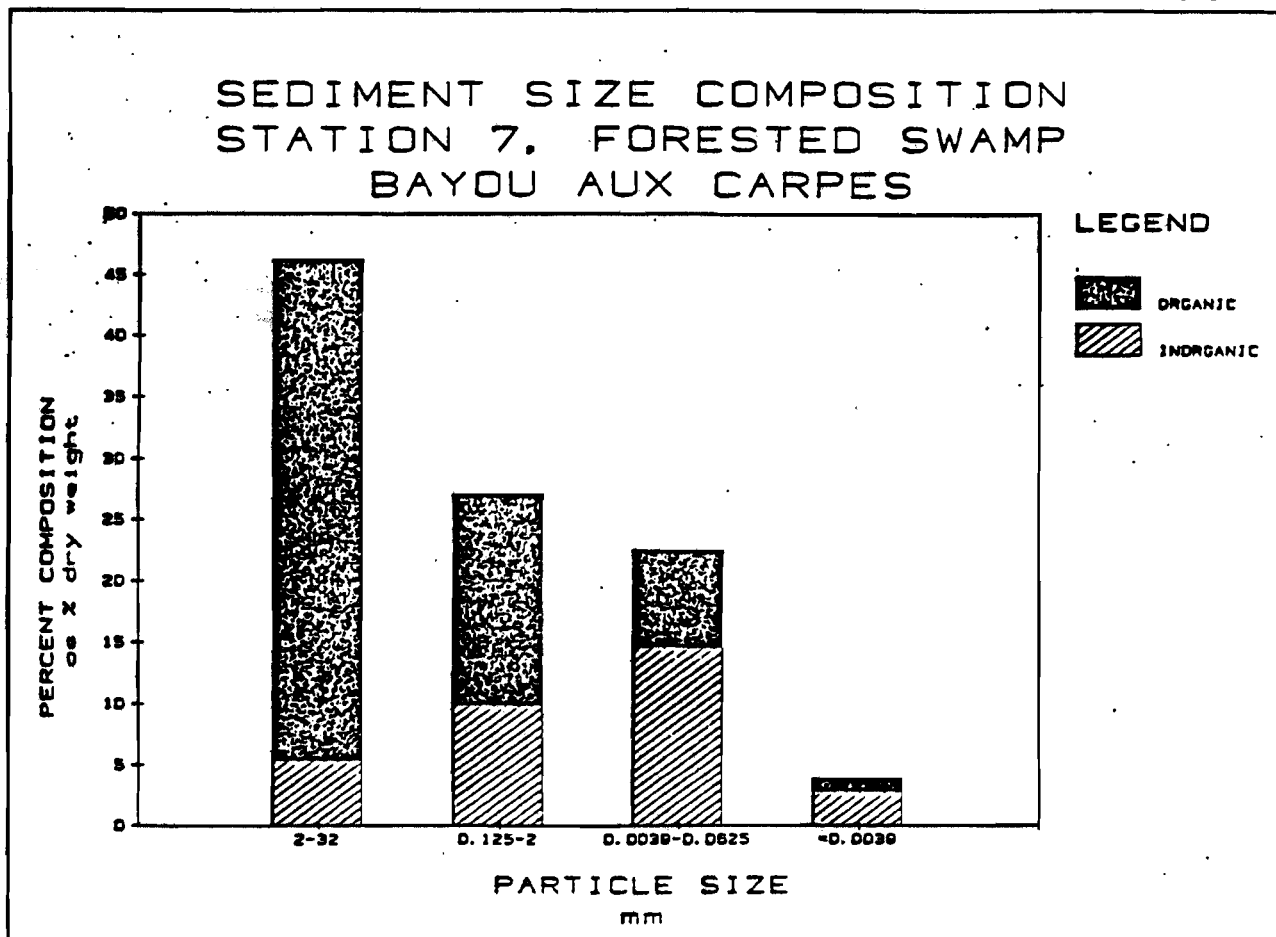


FIGURE 22
 SEDIMENT METALS mg/kg [dry wt.]
 BAYOU AUX CARPES
 JANUARY, 1985

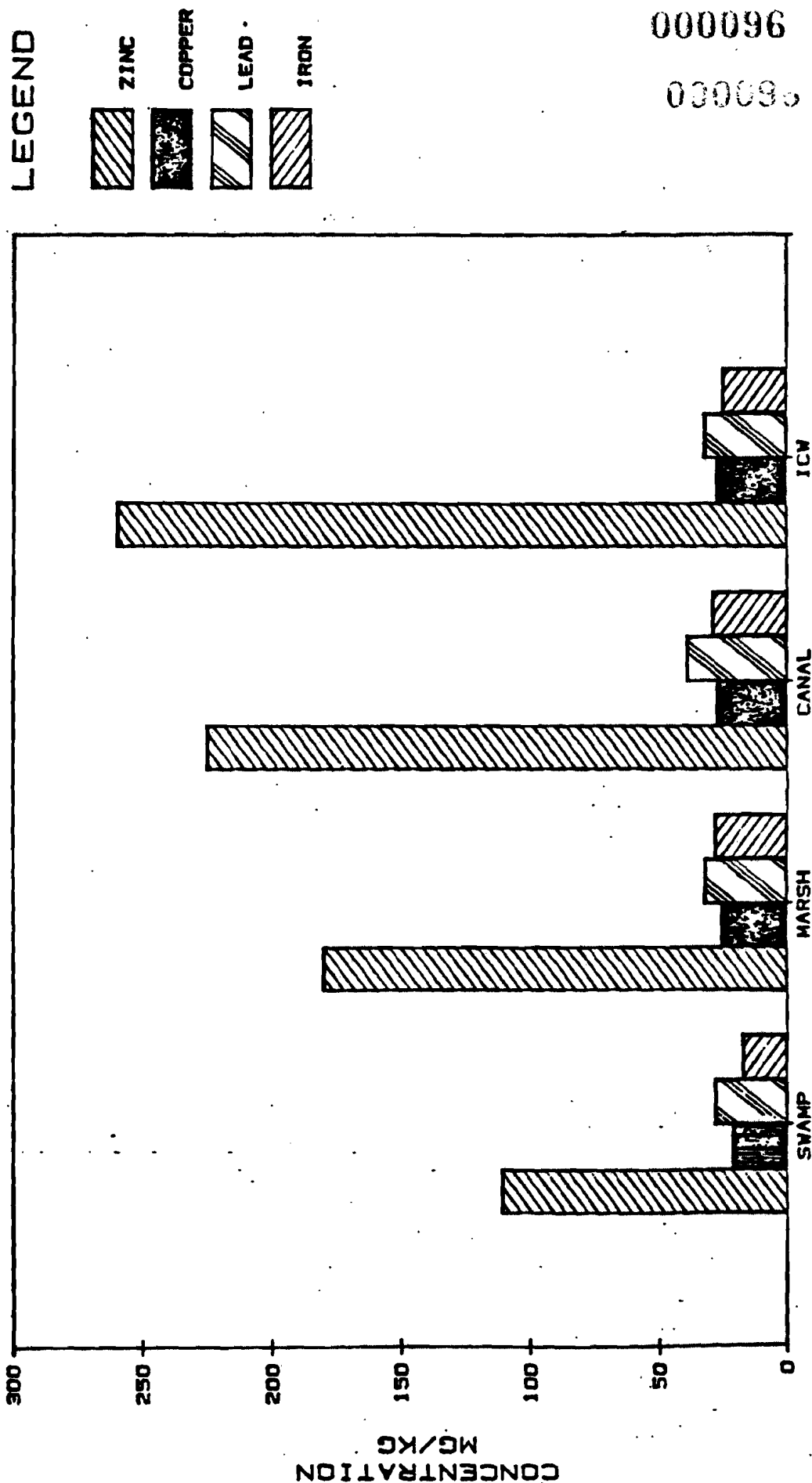


FIGURE 23
SEASONAL DISTRIBUTION
WATER LEVELS AT BARATARIA
JAN - DEC. 1984

000097

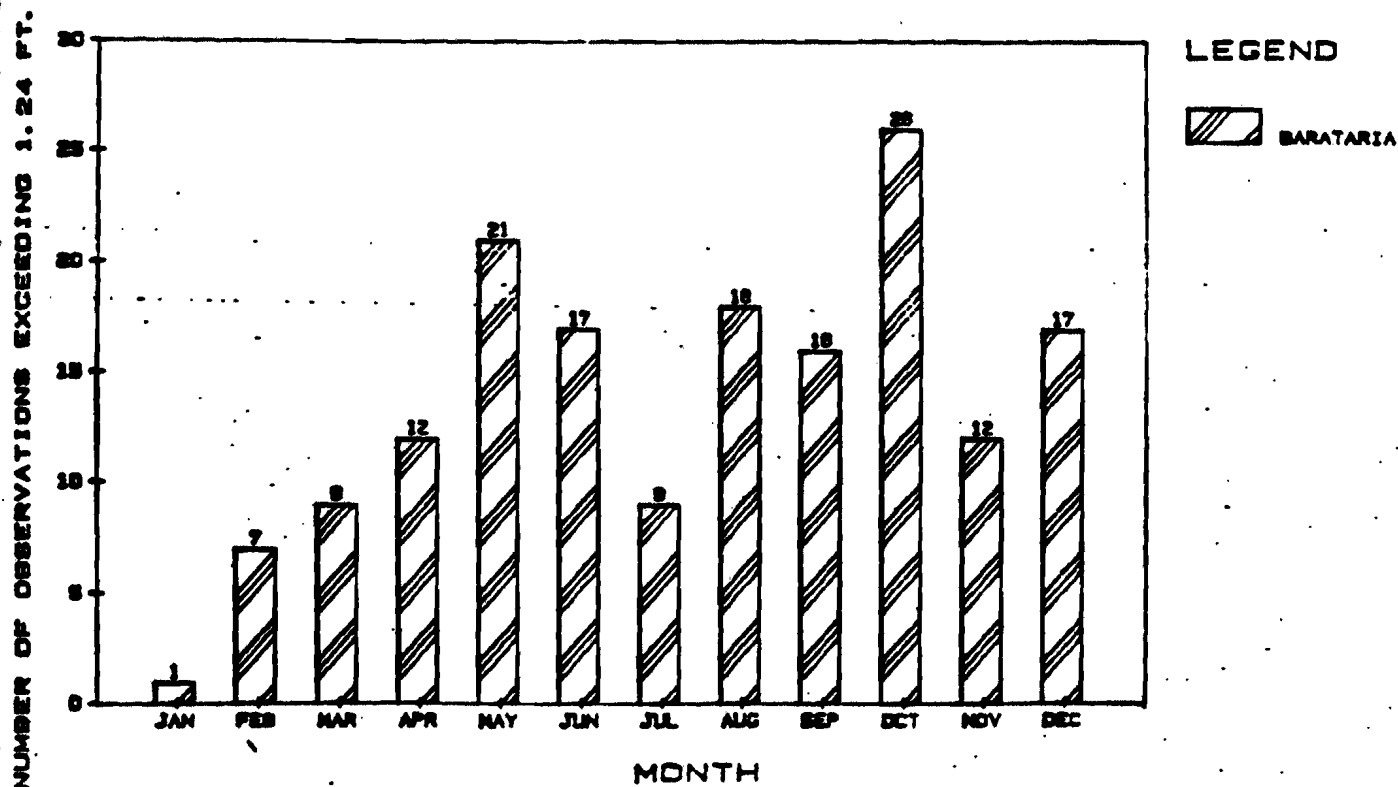
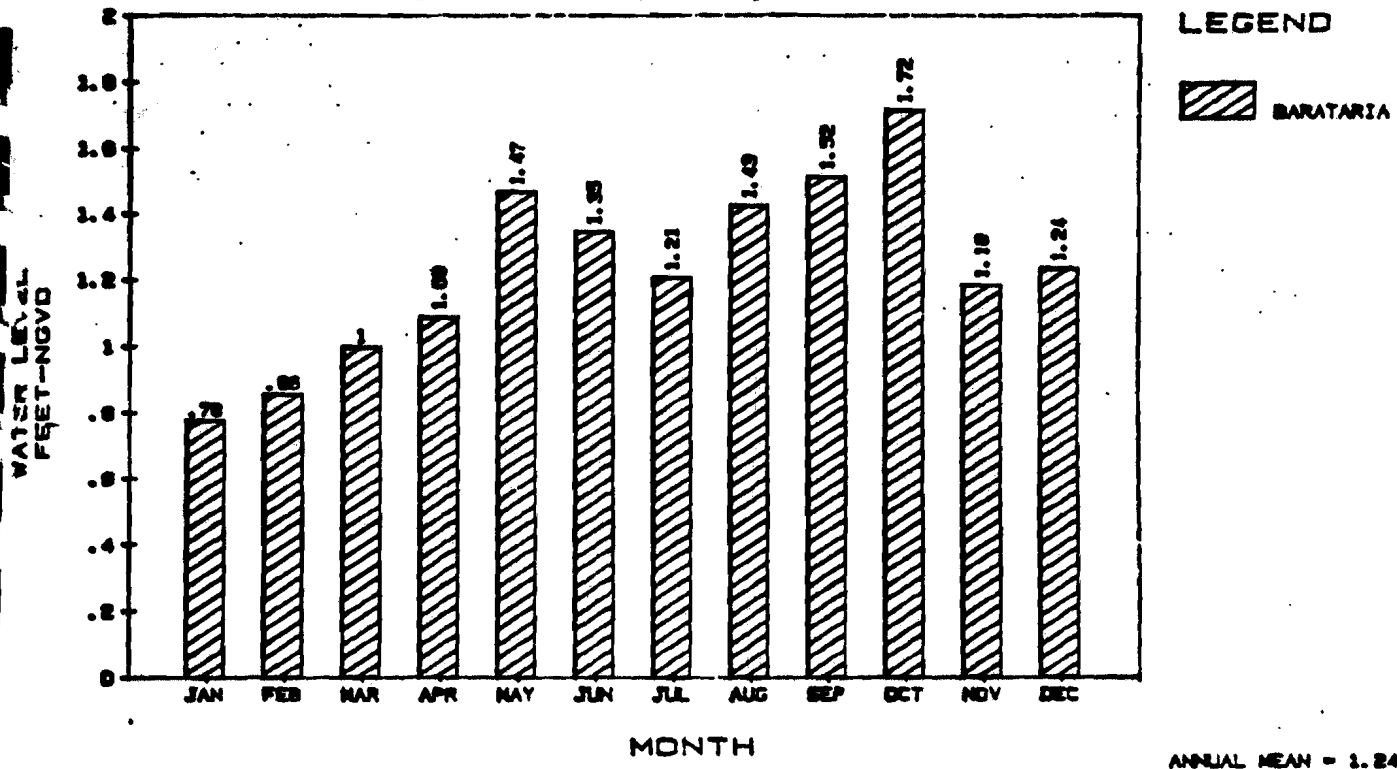


Figure 24

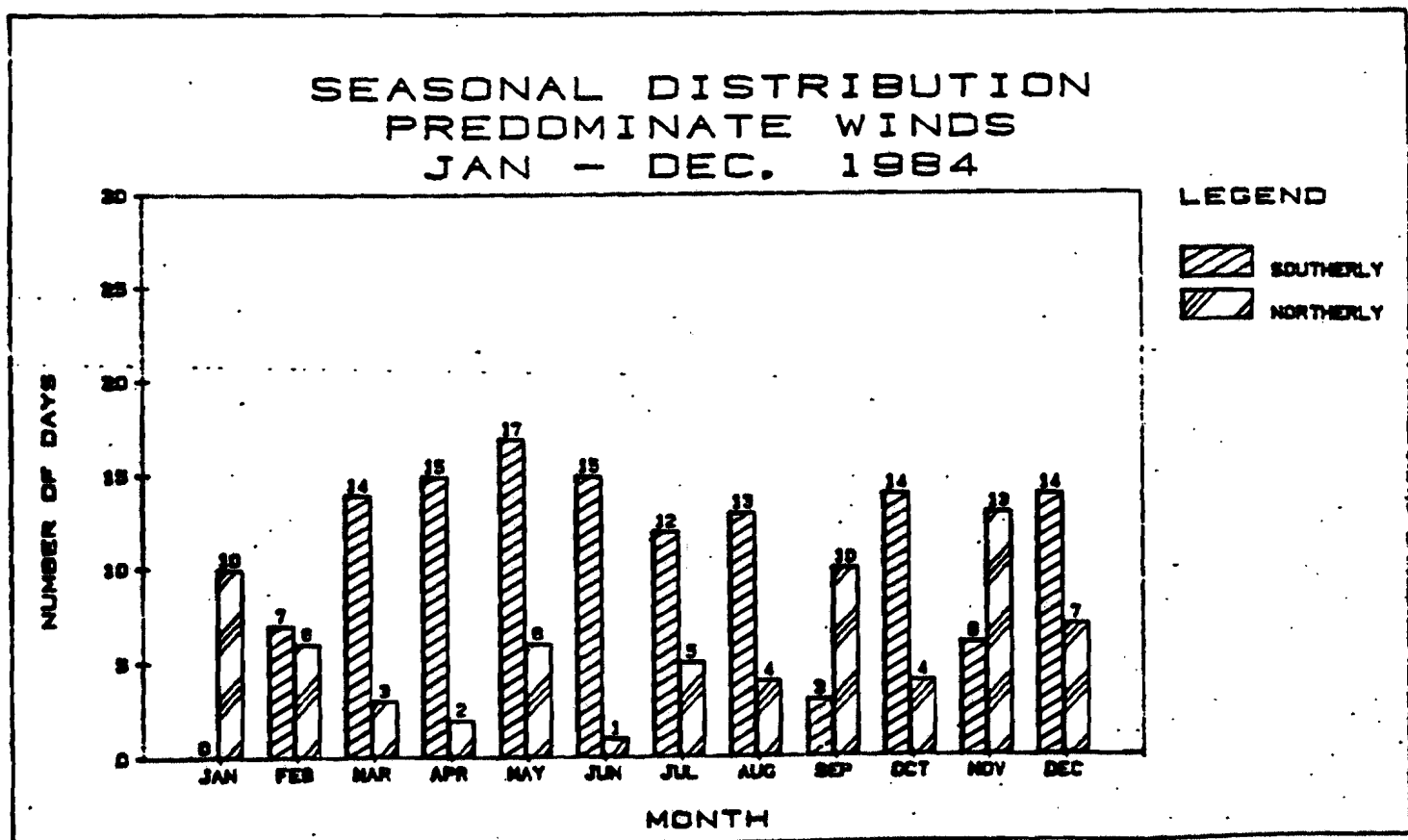
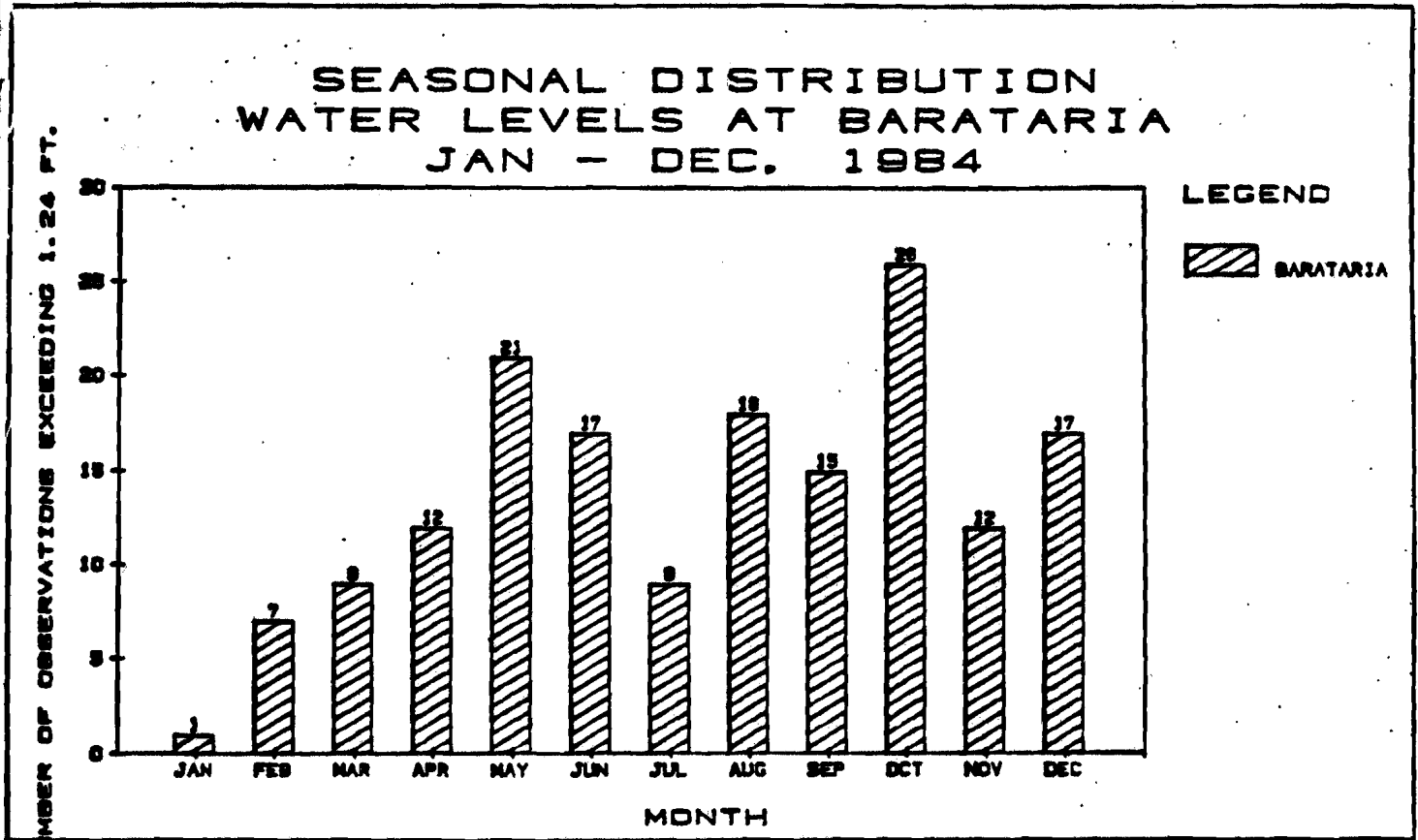
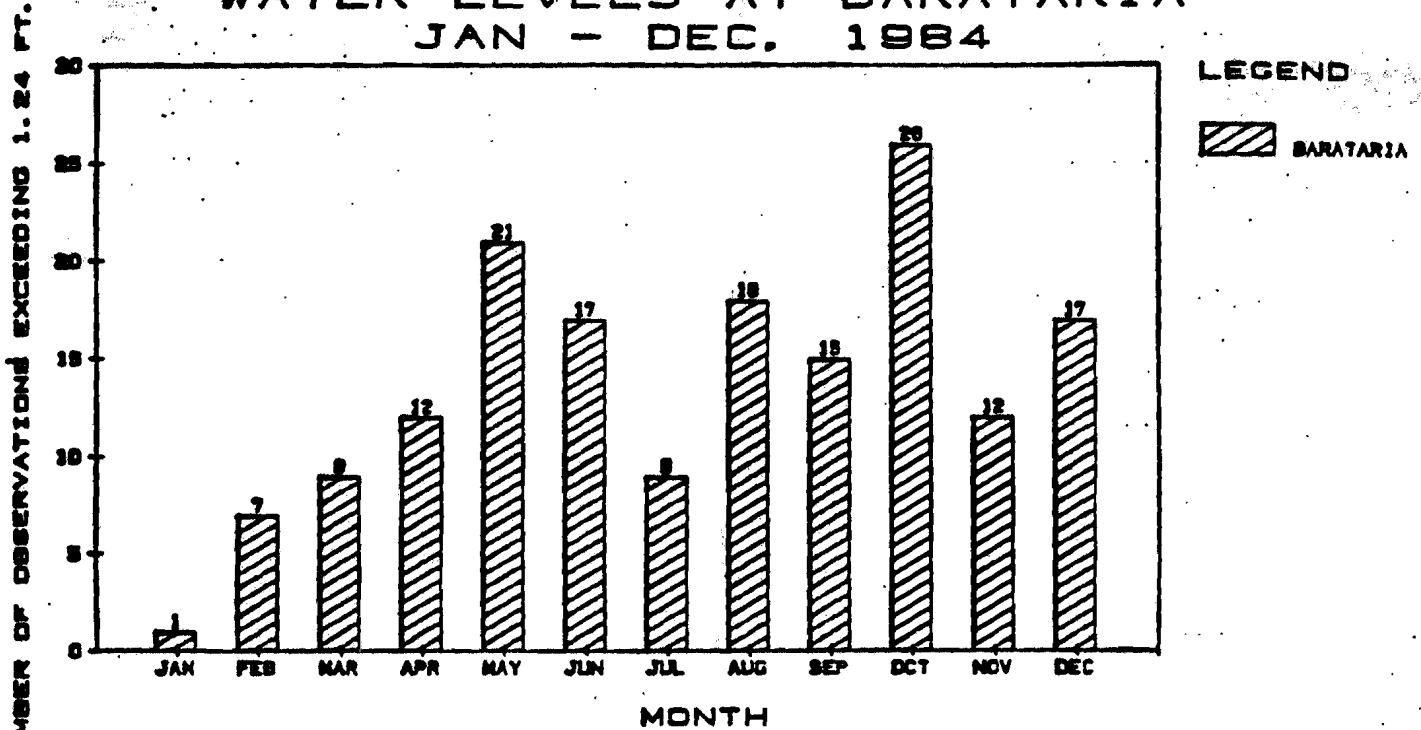
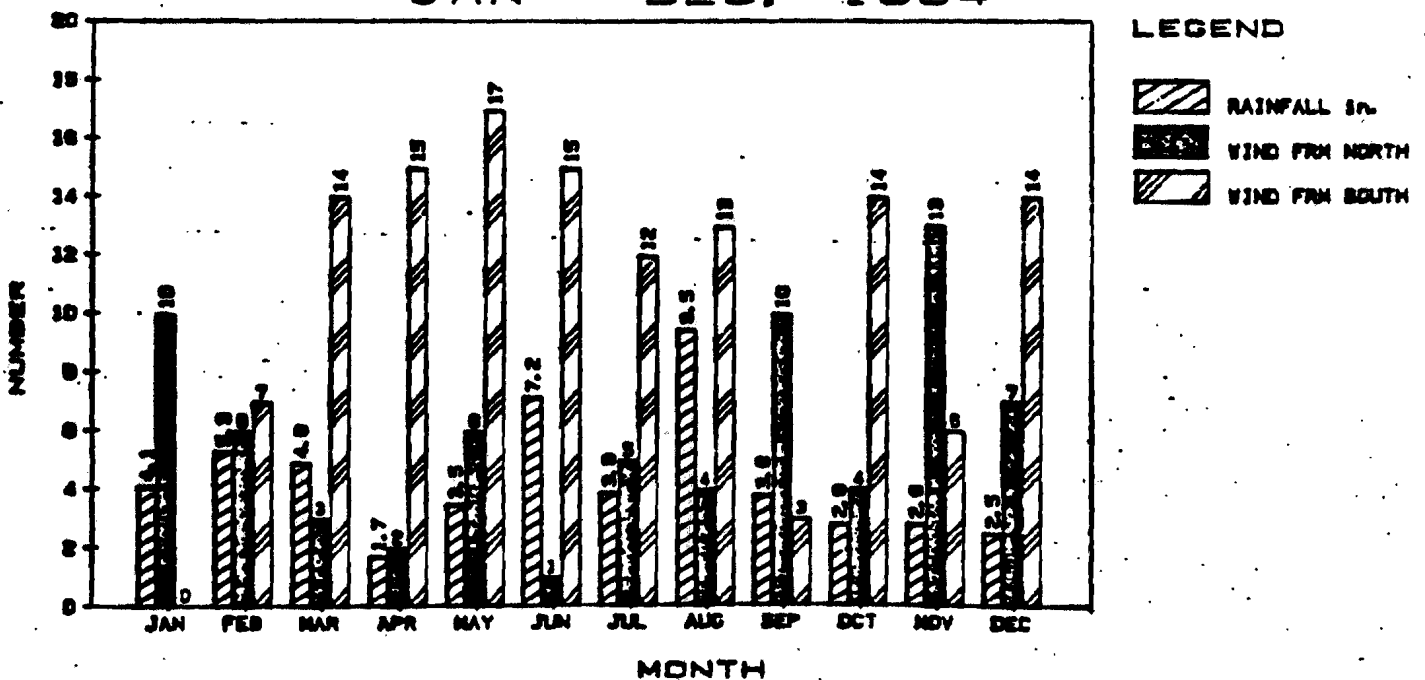


Figure 25

SEASONAL DISTRIBUTION WATER LEVELS AT BARATARIA JAN - DEC. 1984



SEASONAL DISTRIBUTION RAINFALL & WIND DIRECTION JAN - DEC. 1984



000100

000100

APPENDIX A

000101

000101

APPENDIX A

Harvey Canal-Bayou Barataria Levee Project

March 31, 1976

See Below

Mr. John C. White
Regional Administrator
EPA Region VI

SUMMARY

As requested, we have surveyed the subject project and offer the following conclusions. The 3,700-acre tract of wetlands, as it presently relates to the subject project, remains a valuable and viable parcel of swamp and marsh area. In view of the value of this resource, we consider Region VI's decision to request use of a floodgate instead of a pumping station as reasonable, appropriate, and justifiable.

ACTION

For your information.

BACKGROUND

At your request, we reviewed the present status of the subject project and determined if existing alterations have impaired the functioning of the 3,700-acre wetlands to the extent that environmental impacts of completing the project (i.e., pumped drainage of the wetlands) would be trivial. The review was completed the week of March 22 and consisted of briefings, a site visit to the project area and surrounding environs, and a review of available documents. The briefings were by Mr. Peter W. Dunsavage of your office and by staff members of the New Orleans District Corps of Engineers office (list of attendees at March 23, 1976, meeting is attached). The site visit was accomplished with the aid of a helicopter. Pertinent documents were provided by the COE staff.

To complete our evaluation, it will be necessary to briefly describe the site and the project as they relate to the Barataria Bay system.

The Site - The Harvey Canal-Bayou Barataria Levee project is an 11,700-acre (18.3-square-mile) tract located near the headwaters of the Barataria Bay system. The 3,700 acres (5.8 square miles) of the project with which we are concerned is predominantly a freshwater system of mainly swamp and some marsh. The site is near sea level, has an imperceptible gradient, and is subject to only a slight tidal influence (0.25 foot).

The Barataria Bay drainage basin, including the 3,700-acre site, is approximately 1,900 square miles and is characterized by distinct parallel zones of vegetation which are noted below.

- Freshwater swamps - Headwaters of the basin featuring swamp forests (cypress, gum, etc.) with salinity less than 1 ppt.
- Freshwater marshes - Immediately seaward of swamps and comprised mainly of herbaceous vegetation with salinity less than 1 ppt; extensive in upper-central portion of basin.
- Intermediate and brackish marshes - Transition zone from fresh to salt marsh with salinity 5 to 10 ppt.
- Salt marsh - Most seaward extension of vegetation (except for scattered mangrove stands near some of the isles) with average salinity near 17 ppt.

From the above it can be seen that these vegetational zones are highly correlated with a specific salinity regime, thus showing that spatial and temporal variation in the salinity gradient is controlled by freshwater runoff from the drainage basin where the annual rainfall averages 60 inches. Reversals of gradient occasionally occur during periods of high runoff from the Mississippi River.

According to the reports reviewed, Louisiana leads all states in the volume of commercial fish and shellfish harvested. Ninety percent of the harvest is of estuarine-dependent species. Barataria Bay, in turn, is described as the singly most productive estuarine area along the Louisiana coast. Reports of the LSU Center for Wetland Resources clearly indicate that Louisiana estuaries owe their high productivity largely to the extensive systems of marshes and swamps at the land-water interface and to the broad, brackish zones where salinity fluctuations are tempered by continuous freshwater inputs from interior storage areas (i.e., the freshwater swamps and marshes).

The Project - The Harvey Canal-Bayou Barataria project involves two distinct subareas:

- An 8,000-acre tract whose levees and pumping stations are installed and operated by local interests.
- A 3,700-acre tract immediately seaward of the 8,000-acre tract which was unleveed and undrained at the beginning of the federal project. For purposes of this discussion, reference to the "federal project" will allude specifically to the 3,700-acre tract.

Construction of initial levees for the "federal project" were completed by the Corps of Engineers in November 1973. Gaps in the levee were left at Bayou Aux Carpes, the Southern Natural Gas pipeline, and a partial opening at Bayou Des Familles. Subsequent to completion of the levee, local interests have completed closure of the Bayou Aux Carpes opening using clam-shell fill. Plans call for reclamation of the 3,700-acre tract by pump drainage via a pumping station to be installed at the Bayou Aux Carpes closure. At present, circulation of water between the 3,700-acre tract and the Intracoastal Waterway is via the Southern Natural Gas pipeline canal.

Importance of Site - Freshwater swamps and marshes in coastal areas perform several critical functions including:

- Efficient producers of organic matter which support an indigenous fauna, and surpluses are exported to fuel downstream systems.
- Serve as freshwater storage and recharge areas which control the rate and timing of freshwater inputs to downstream estuaries, thus maintain a broad zone of salinity gradient throughout the year.
- Support an indigenous flora and fauna which is of direct value to man for recreation, esthetics, sport fishing, and timber production.

Based on observations made during our visit, the 3,700-acre tract is still performing all of the above functions. The Cypress-Tupelo Swamp and the fresh marshes will remain viable as long as they are not drained. It is reasonable to expect that they will continue to produce significant quantities of organic matter to fuel the system. Closure of Bayou Aux Carpes and the reduction of sheet flow from the system has undoubtedly lessened the export of organic matter to downstream systems; however, the Southern Natural Gas pipeline canal still serves as a major export route of organic material produced in the swamps and marshes. Installation of a floodgate at Bayou Aux Carpes, as recommended by EPA Region VI would provide an additional avenue for export of detritus to downstream systems.

Perhaps the most important function of the freshwater swamps and marshes in the Barataria Bay system is the amelioration of fluctuations in freshwater inputs to the estuary during periodic wet and dry periods. Since the swamp and marsh are intact and connected to the rest of the system via the pipeline canal, this important function is still taking place.

According to reports of the LSU Center for Wetland Resources, the salinity of Barataria Bay is determined by basin runoff and inputs from the Mississippi River. The basin runoff, however, is the major determinant of the salinity gradient and also serves in a buffering capacity to maintain uniform salinity throughout the water year. According to these same reports, the 3,700-acre tract is part of the zone of major freshwater storage for the Barataria Bay system. Loss of such storage areas via drainage increases the amplitude of salinity variations in the brackish zone.

A brief example illustrates the change in freshwater runoff characteristics brought about by pump drainage:

Hydrologic data:

1. Annual rainfall = 60 inches
2. Annual runoff = 20 inches (40 inches consumed by evapotranspiration)
3. Rate of discharge following rainfall = 0.20 inch per day.

Thus:

1. From 2 above, the mean annual runoff rate from 3,700 acres = 8.5 cfs
2. From 3 above, the runoff rate following rainfall = 31.1 cfs

Based on this analysis, it is apparent that the initial 150-cfs pump to be installed will move rainfall at a rate five times greater than the natural system. As pointed out by the Corps, the initial 150-cfs installation will only drain a portion of the area. Larger-capacity pumps will ultimately be installed, thus further increasing the rate of de-watering as compared with the natural system.

Finally, we have no doubt that the existing 3,700 acres of wetlands continues to support an indigenous biota of direct value to man. The present diking of the 3,700 acres of wetlands may have reduced public access to the area; but it fails to eliminate any of the recreational, esthetical, or sport-fishing features of the tract. In addition, the potential timber value of the cypress trees remains as a renewable resource if the area is not drained.

Writers: L.B. Tebo, Jr., S&A, Region IV
Delbert B. Hicks, S&A, Region IV
Thomas R. Cavinder, S&A, Region IV
Victor W. Lambou, EM&S Lab., Las Vegas

Attachment

LBTebo:pc:2294:3/31/76